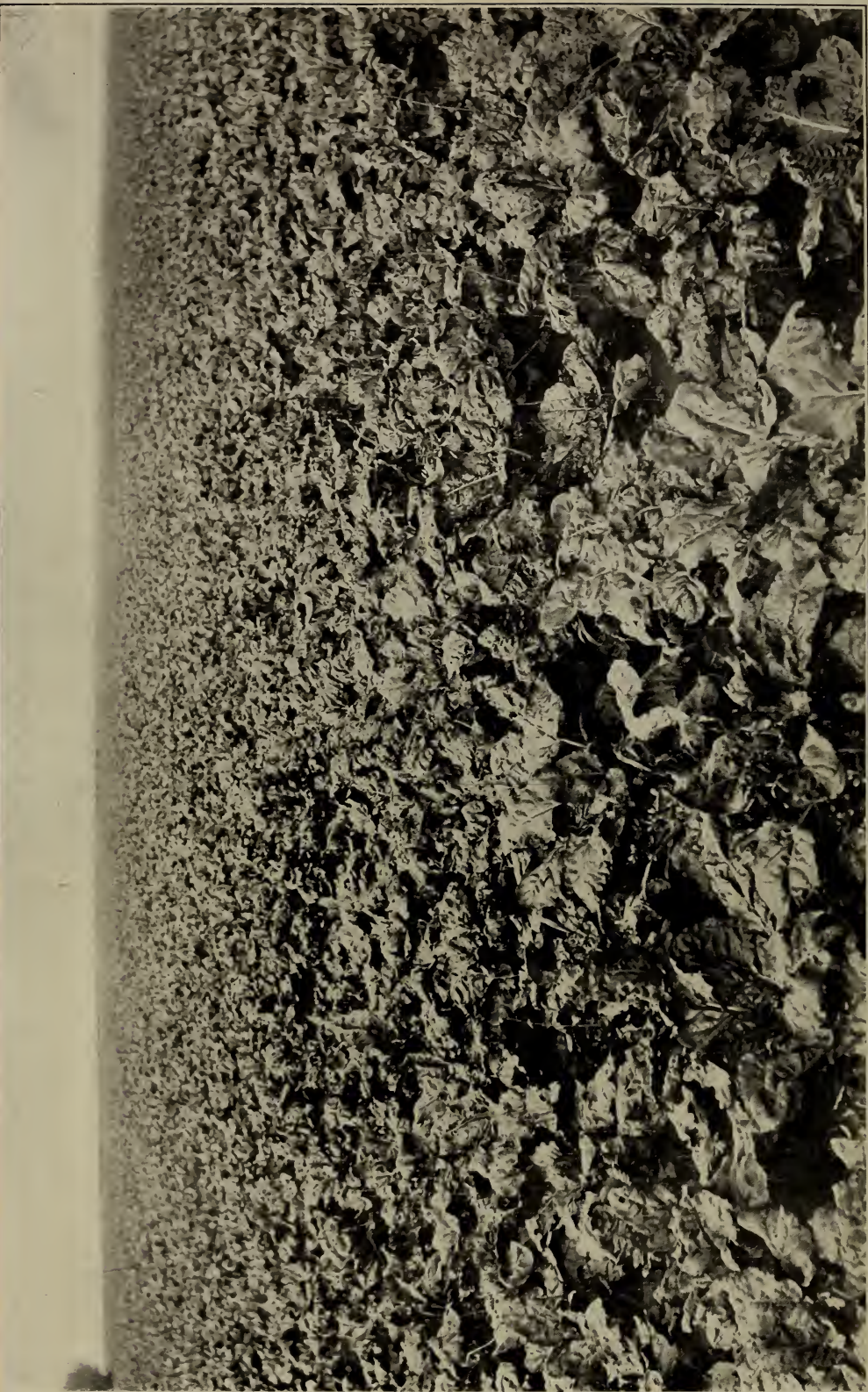


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FIELD OF BEETS, AMES, NEBR.

U. S. DEPARTMENT OF AGRICULTURE.

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Report No. 72.

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PROGRESS

OF THE

BEET-SUGAR INDUSTRY

IN

THE UNITED STATES


IN

1901.



WASHINGTON:  
GOVERNMENT PRINTING OFFICE,  
1902.





Congress having failed to authorize the printing of an edition of this publication (known as Senate Document No. 316, Fifty-seventh Congress, first session), 5,000 copies were ordered by the Department for its own use.



MESSAGE  
FROM THE  
PRESIDENT OF THE UNITED STATES,

TRANSMITTING

A COMMUNICATION FROM THE SECRETARY OF AGRICULTURE  
COVERING A REPORT ON THE PROGRESS OF THE BEET-SUGAR  
INDUSTRY IN THE UNITED STATES DURING THE YEAR 1901;  
ALSO THE RECOMMENDATION OF THE SECRETARY THAT 10,000  
COPIES BE PRINTED FOR THE USE OF THE DEPARTMENT.

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APRIL 24, 1902.—Read; referred to the Committee on Printing and ordered to be  
printed.

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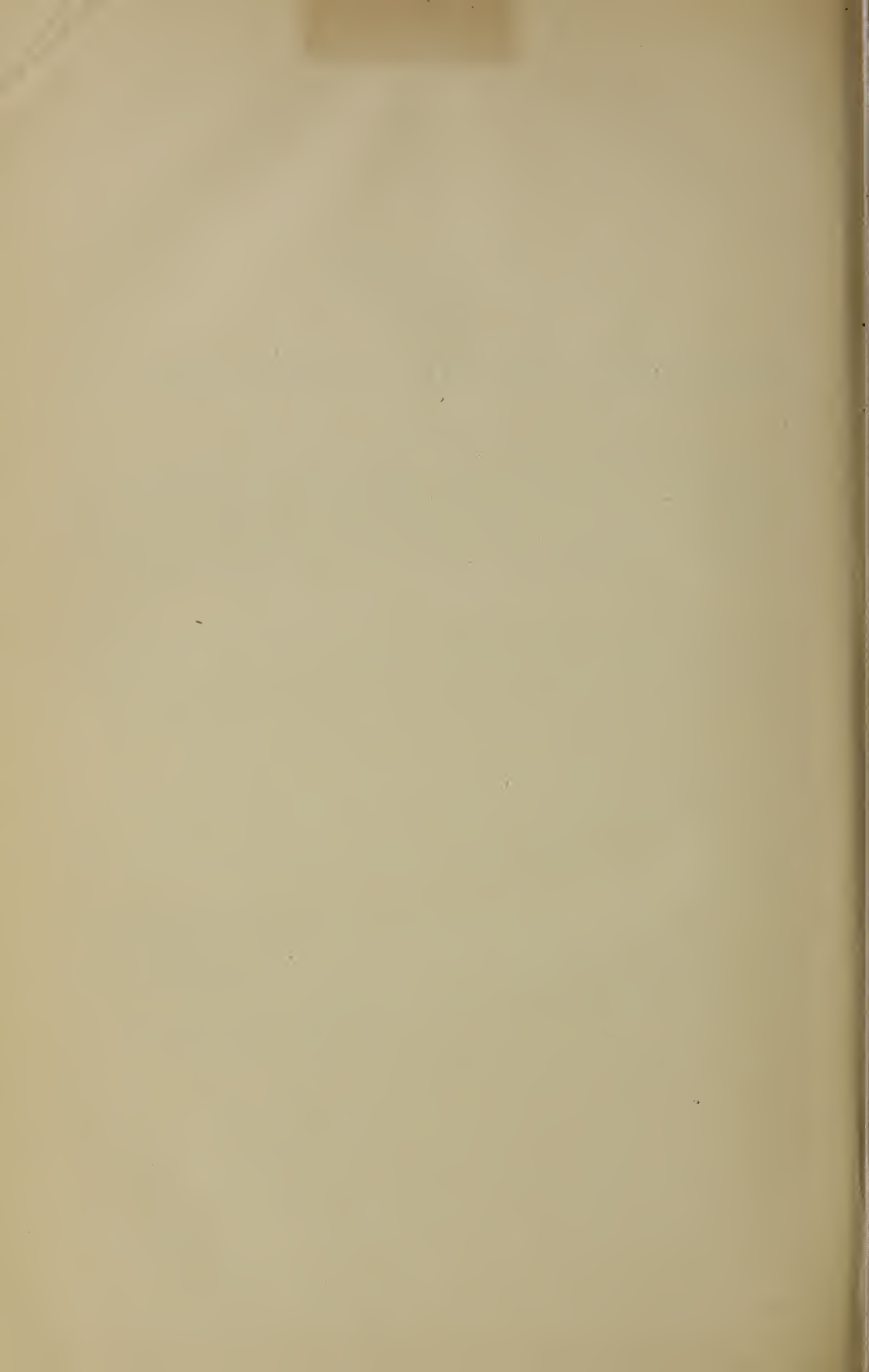
*To the Senate and House of Representatives:*

I transmit herewith, for the information of the Congress, a communication from the Secretary of Agriculture, covering a report on the Progress of the Beet-Sugar Industry in the United States during the year 1901.

Your attention is invited to the recommendation of the Secretary of Agriculture that 10,000 copies of the report be printed for the use of the Department, in addition to such number as may be desired for the use of the Senate and House of Representatives.

THEODORE ROOSEVELT.

WHITE HOUSE, *April 23, 1902.*



## LETTER OF TRANSMITTAL.

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DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
*Washington, D. C., March 26, 1902.*

MR. PRESIDENT: I have the honor to transmit, for your information and that of the Congress of the United States, a report on the Progress of the Beet-Sugar Industry for 1901.

This report is composed of two parts, the first prepared by Charles F. Saylor, special agent of this Department, and the second in the Bureau of Plant Industry.

In the first part Mr. Saylor reports the operations of the various beet-sugar factories, outlines the proper methods for use in growing beets, and presents a mass of pertinent statistical information.

In the second part are presented (1) a discussion of the insect enemies and fungous diseases attacking sugar beets, and the methods of combating the same; and (2) a report on the production of sugar-beet seed, a branch of the industry which is now receiving some attention in this country.

From a careful study of the report and observation in the field, I am satisfied that the future of the beet-sugar industry depends more upon correct farming than any other one consideration. The tonnage reported is 9.6 per acre, but this can be greatly increased by a proper system of crop rotation (to keep the soil supplied with organic matter), thorough cultivation, and fertilizing where necessary.

A weak place in the industry is the lack of a proper disposal of the by-products of the factories, the value of which is not sufficiently appreciated by our people. It has been ascertained in all European countries where the industry is well established, that the pulp, after the sugar is extracted, is valuable for feeding to all domestic animals. Our people are learning this, and when it is fully comprehended this crop will be grown by farmers with a view to using this by-product to take the place of other mill feeds on the farm.

In view of the importance of the subject, I have the honor to recom-



mend that at least 10,000 copies of this report be printed for the use of this Department, in addition to the number which Congress may in its wisdom order for the use of the members thereof.

I have the honor to remain, Mr. President,

Very respectfully,

JAMES WILSON,  
*Secretary.*

The PRESIDENT,  
*White House.*

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# PROGRESS OF THE BEET-SUGAR INDUSTRY IN THE UNITED STATES IN 1901.

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## REPORT OF SPECIAL AGENT,

CHARLES F. SAYLOR

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## LETTER OF SUBMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SPECIAL AGENT,  
*Washington, D. C., March 17, 1902.*

SIR: I submit herewith, for your inspection and approval, my report for 1901 as special agent for the investigation of the sugar industry. It includes the results of my own observations and investigations, and a considerable mass of information pertinent to the subject collected from various reliable sources.

CHARLES F. SAYLOR,  
*Special Agent.*

HON. JAMES WILSON,  
*Secretary of Agriculture.*

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## INTRODUCTION.

In reporting the progress made in the development of the beet-sugar industry for 1901, I wish to call attention especially to the continued and rapidly increasing interest in the subject among all classes of people. Everything considered, this public interest and the rapidity with which the industry itself is assuming substantial form is remarkable. It is not confined to any particular section of the sugar-beet area, but appears to be about as definitely appreciated and understood in one as another. In some States circumstances have led to prompter action in establishing the industry; at the same time every available part of this area is being carefully tested and studied preparatory to definite future action. When agitation as to the future of the sugar market shall have ceased by definite settlement of the questions involved, the progress of the beet-sugar industry in the United States will be more stable and progressive.

To illustrate the development of the industry the State of Michigan may be cited. That State will have 17 factories in operation during the campaign of 1902, a result accomplished in the space of four years. The thing that made Michigan a peculiarly favorable field for the introduction of this industry was the fact that it could be built up on the foundations of another—the lumber industry, which is waning. There are 30 more projects under consideration and probably more factories will be built in the near future.

When Utah began to manufacture sugar from beets it was found necessary to produce them by irrigation, like other agricultural crops, and here the problem of raising beets by irrigation was worked out. Fortunately the experiment was tried under favorable conditions. No other country was able to furnish us any definite facts bearing on this subject. The results of these experiments in Utah were of vital interest to the people of the whole arid region. In many sections the people profited by the results of Utah's experience, and the arid region, through sugar-beet culture and its benefits, assumed a greatly increased importance. It must be regarded as an important factor in the future, not only in the production of sugar, but in general agriculture.

#### LOWERING THE COST OF SUGAR PRODUCTION.

We are gradually emerging from the experimental stage of sugar-beet growing. Some very valuable deductions can be made from a study of this experimental period. American methods in general agriculture are studied by all other countries. They represent the best. But in the cultivation of sugar beets Americans have been the students of the methods in vogue in foreign countries. These methods we have been applying. Meanwhile we have been studying the results and gradually developing methods of our own. Our experience has carried us into fields hitherto undeveloped—for instance, the growing of sugar beets by irrigation. We have also depended largely on the natural fertility of the soil, while Europe must resort to expensive fertilization.

The United States present so many different kinds of agricultural conditions that a fund of information based on experience was necessary. In growing sugar beets we started with set theories and fixed rules for all cases regardless of varying conditions, but we have found that specific rules can not be given general application. Methods suited to conditions had to be developed through experience, and the same is true of beet growing in other countries, as will be seen by a study of the development of the industry in Germany.

In 1878 the German beets averaged 9.24 per cent sugar content. Their beets gradually improved from year to year until, after twenty years, the average sugar content of the German beets in 1898 was

13.15 per cent. This was a remarkable improvement, the increase for the period being 3.91 per cent. This was doubly important from the fact that, not only did the factory get 42.31 per cent more sugar at the close of the period, but they secured beets from which it cost a great deal less to extract the sugar. In twenty years Germany decreased her cost of production of sugar over one-half, and it is this future prospect that gives the beet-sugar industry in this country a standing. We must have the experience, and we must have the opportunity to get it. We can feel assured that when we do get it the cost of production will be a great deal less than it is to-day. This can not be brought about simply by taking the experience of the foreigner and applying it, but it must be accomplished by studying proper systems of cultivation under our own conditions. It is also definitely settled that we can not take the methods used in one section or State and apply them in some other section or State. Even in different sections of the arid region radically different methods must be applied.

We should eventually manufacture at least sugar enough to supply our own needs. In order that it shall have the sympathy of the public, it must be made clear that some time in the future this industry will stand on its own merits and be able to meet the competition of other sugar-producing countries.

The cost of producing sugar, as shown by the last census report on this subject, was such that the manufacturers of sugar, taking the average of all the factories, made but a small margin above the cost of production. If the wear and tear of the machinery had been taken into consideration, they would have been making sugar at a slight loss. There is, however, a tendency towards a lower cost of production in this country the same as has occurred in all other beet-sugar producing countries. Some of our older factories are now producing sugar for three-fourths of this average cost. It is not because they have any better natural advantages, and it is not reasonable to suppose that this difference in cost of production will be permanent. The only apparent reason for their lower cost of production is experience. In ten years, these older factories have reduced their cost of production from 25 to 33½ per cent. In the years to come a very considerable reduction may be looked for and the other factories coming into operation will have reached a cost of production at least as favorable as that of the original factories now is.

#### COST AND PROFITS OF BEET PRODUCTION.

It costs about \$30 per acre to produce sugar beets and to market the crop where rain conditions prevail. This is without taking into consideration the rent of the land, but it includes the farmer's time and everything else that enters into the cost of production. Accord-



ing to the table on page 36 the average yield of sugar beets for 1901 was 9.6 tons per acre. Abundant evidence exists, however, to show that this is exceptionally low, and that adequate care and suitable methods of cultivation promise a very much higher average of yield. In making the following calculations I have taken as a basis an average yield of 12 tons per acre. The experience of all careful growers will show this estimated average to be under rather than over the mark. The cost of production will decrease gradually because of improvements in implements and methods. The beets grown have a gross value at the factories of \$4 to \$4.50 per ton (in States paying no bounty). This gives a gross return per acre of \$48 to \$54, and a net profit of \$18 to \$24. It must be kept in mind that these are averages of gross and net proceeds. It is never very encouraging to consult the average of agricultural crop statistics; indeed, it is often said that "the average crop does not pay." If one should take the figures of the average crop of corn in Iowa, for instance, or the average crop of wheat in Minnesota or Kansas, and compute the proceeds at the average market price and deduct therefrom the cost of production, the results would show a very small remuneration or an actual loss quite discouraging to one who has not investigated this subject.

Taking what seems to be the most authentic figures, the cost of producing sugar beets in sections where they are grown by irrigation is about \$40 per acre. An average of 13 tons per acre can be produced having a higher sugar content and worth \$4.50 to \$5 per ton, making the gross proceeds \$58.50 to \$65 and the net profit \$18.50 to \$25 per acre. These figures give to the farmer in each case a profit greatly more satisfactory than in the case of other crops. But the successful farmer will never be satisfied with the average proceeds of any crop, and it is to him we must look for the results that give the more encouraging inducements to beet culture. Many growers receive as high as \$75, and some as high as \$100, per acre for their beets, these high results depending upon the superior quality of the land and the superior skill of the one producing the beets. If a farmer has poor land or is a poor farmer, he is not in a position to expect much in planting any kind of crop. These statements are sufficient to give a farmer who is experienced in all other kinds of crops a fair insight into the situation.

#### THE SUGAR-BEET BELT.

Experience throughout the United States has demonstrated that sugar beets do best in localities having certain climatic conditions. Up to date a large strip of land reaching across the northern portion of our country has given the most satisfactory results in growing sugar beets. It starts at the Hudson, takes in the southern half of New York, the northern portions of Pennsylvania, Ohio, Indiana,

Illinois, Iowa, and Nebraska, the southern half of Michigan, Wisconsin, and Minnesota, all of South Dakota, large sections of Colorado, Utah, Wyoming, Montana, Idaho, Washington, Oregon, and the coast side of California.

The mapping out of this belt is based on temperature conditions only. Throughout large areas included in the belt other conditions make the growing of sugar beets either impossible or unprofitable. But there are many districts where this industry succeeds. The actual location of such can only be determined by experiment. It would be impossible to locate them on a map at present, as many of them are as yet undetermined. By consulting the published experimental results in bulletins of the State experiment stations and the reports that have been issued by the Department of Agriculture, much accurate information can be obtained with reference to many of these lands. There are valleys in the arid regions of the Rocky Mountains having the right conditions, with sufficient water supply for irrigation, that have reached results never before equaled with sugar beets, even in countries that have been working with the industry for a half century.

The State agricultural experiment stations have done much pioneer work in determining whether the prevalent conditions in their respective States are favorable or unfavorable to the beet-sugar industry. The Department of Agriculture has given considerable attention to this problem. It has cooperated with the State experiment stations so far as feasible; has pursued independent investigations wherever practicable, and has published the results in reports and bulletins. Results are given by counties and States, and show averages of quality and purity of sugar beets grown. These results have been placed in comparison with the results arrived at by the experiment stations. This work has been repeated year after year, so that the public might discern the extreme either of favorable or unfavorable years, and estimate the effects of normal conditions in normal years.

#### INCIDENTAL BENEFITS AND BY-PRODUCTS.

In this modern and scientific age nothing should be allowed to go to waste, and the question of by-products is an important feature of every industry. It is a question of special importance in view of the high cost of production incidental to the superior standard of living prevalent in this country. Besides the important matter of by-products, due consideration must also be given to the incidental benefits resulting from the growth of sugar beets.

#### IMPROVEMENT OF LAND AND FARMING.

The high cultivation that must be given the land through deep plowing, thorough harrowing, and constant weeding and cultivating finally makes the land of superior quality for any purpose. It will grow



better corn or wheat, and at a less expense, on account of the absence of weeds and grass. Finally, through rotation, other fields are brought under this high state of cultivation, until the whole farm is at its best condition of soil fertility and productiveness.

In the study of beet farming in Germany and France it is interesting to note the progress that has been made in general agriculture through sugar-beet growing. A great many intelligent Americans have gone to Germany and France to inform themselves on this subject. There a farm is blocked off into a series of divisions, corresponding to the crops that are grown in rotation. This rotation is settled for several years in advance and is followed very strictly. Sugar beets are grown on certain fields one year, followed by other crops in the series, to be followed again by sugar beets in their proper place in the rotation.

By their system of fertilization the fertility of their soils has not only been maintained, but they have been made to increase in productiveness. These results are brought about partially by cultivation. The deep plowing and constant cultivation with the plow and hoe naturally keep the soil in the finest condition. What is true of these older countries will be true of our country in the end. Improvement of the land is a factor that we must not lose sight of in considering the benefits of the beet-sugar industry of this country.

The difficulties of growing sugar beets are so many, and to the factories the success of the growers means so much, that it is the custom of each factory to have a farm superintendent. In Europe more stress is put upon the work of this officer than almost any other one connected with the sugar company. He is not only required to be trained by long practical experience in agriculture, but he must be a thorough scientist. He is paid a salary commensurate with his importance. A farm superintendent is employed also in American factories. We have not as yet gone so far in the requirement of scientific training, but the tendency is growing strongly in this direction. When contracts are made with the farmers, a clause is inserted requiring beets to be grown as the farm superintendent directs. Either he or his assistant visits the farms repeatedly, offering the farmers instructions on how to prepare the ground, how to cultivate, and how to do all other necessary work in growing beets successfully. He gives advice to the farmers in regard to meeting contingencies; decides when the beets are ripe, and issues the orders directing the farmers to deliver their beets to the factory. His work is a very vital part of the business. He is a constant stimulator to agricultural improvement on the part of the farmers in the neighborhood, and especially to the farmers under his direction. The benefits of this official's instruction and influence to a farming community can hardly be measured in dollars and cents. His influence is not limited to the present but extends to the future. He is one of the important factors in settling what will be the final status



of the industry. It is a very fortunate incident that the work of a sugar factory should bring a farming community under the influence of such trained supervision. It brings a community growing sugar beets under a systematic rotation of crops properly arranged. It gives an intelligent knowledge of the application of fertilizers, and applies the proper scientific methods of cultivation.

#### BEET PULP.

In all my reports I have aimed to emphasize the value of this by-product. I regard it as a feature not to be overshadowed even by the main product, sugar. After the sugar has been extracted from the cossettes or slices, and after the water has been pressed out and the pulp deposited in the silo, it represents about 45 to 50 per cent in weight of the beets that originally produced it. In the beet-sugar producing countries of Europe this pulp is thoroughly appreciated and understood. Some of it is sold to the farmers and the dairymen fresh from the press. The rest of it is dried and pressed and sells on the market at about \$2 per hundredweight, very much as does our oil cake, being purchased for feeding to all kinds of stock.

Pulp as a by-product is of especial value in our own country with its stock and dairy interests. Its value is not to be measured alone by the actual money received for it, but also by the opportunity and encouragement it offers to dairying, stock breeding, and stock feeding. The people of this country have been slow to appreciate the usefulness of pulp. The older factories whose operations date back a decade have not yet been able to dispose of their pulp at its real value. At first new factories usually have to pay for the removal of the pulp in order to get it out of the way. Farmers gradually begin to use it, and stockmen and dairymen test it. After a time factories are able to dispose of the pulp at some figure; but eventually they will be able to dispose of it, as is done in Europe, for what it is actually worth.

The State of New York has large dairy interests. The farmers of this section are accustomed to feeding by-products from the distilleries, breweries, and starch works. When the sugar factories were established in that State pulp feeding came as a matter of course, and those factories were able to dispose of their pulp in the beginning at a higher figure than were the older factories that had been manufacturing sugar from ten to twelve years. Finally all of this pulp will be sought and paid for at its true value the same as other feeds. When that time comes the sugar interests will be greatly benefited.

I made my original investigation of pulp feeding at one of the older factories—the one at Grand Island., Nebr. This factory was unable to interest the farmers in the use of pulp for feeding purposes. A cattle company had investigated the benefits of feeding pulp, and had built at the factory stock pens and yards under the management of Mr.

John I. Riemers, of that city. The bulk of the pulp was unused, being hauled out with a road scraper and dumped on the prairie. When I was there an accumulation including the pulp of four years was lying on the prairie. Mr. Riemers' feeder was using the four-year-old pulp in preference to any of the rest.

During the sugar campaign of 1901, I was at Norfolk, Nebr., where is located one of the factories owned by the American Beet Sugar Company, which also owns the Grand Island enterprise. The factory at Grand Island did not operate last year, but all beets were shipped to Norfolk. This company has an arrangement with the farmers in Nebraska by which the beet growers can secure all their pulp for nothing, provided they want to feed it or use it themselves, but they can not dispose of it to some one else. The company offers the pulp as a sort of premium to beet growers. I was surprised and gratified to learn that some of the farmers from Grand Island were claiming their pulp at Norfolk and having it shipped back by carloads at a cost of at least 25 per cent of the original price they got for their beets.

#### BEET LEAVES.

When the beets are harvested the crowns with the adhering leaves are cleaved from the beets with a sharp knife and allowed to fall on the ground. It is the aim of the person doing this work to cleave the crowns at the line made by the sun, indicating where the beets have projected above the ground. Sometimes a beet projects but little and sometimes a great deal. The amount of the crown cut off depends upon this. I believe it is the best practice among the beet growers to allow these tops and crowns to remain on the ground and be plowed under for fertilizer. In many instances, however, they are gathered up, stored, and fed. In others, stock is turned into the field and allowed to feed upon them as they lie on the ground. Occasionally they are loaded on wagons and hauled to the villages, towns, and cities, and sold for forage the same as hay or other feed.

There can be no doubt about the value of beet tops and beet leaves as feed for stock, nor can there be any doubt as to the importance of keeping up the fertility of the soil by allowing them to remain on the ground. If they are taken off, then fertilizer of some other kind must be used instead. It is simply a question which is the best way to do it.

#### SIRUP MANUFACTURE.

With the production of sugar from beets in the United States has come also the manufacture of sirup for table use, for fruit preserving, and for other purposes. This production is the result of an investigation of this subject by parties living in this country.

One factory is using this sirup in the manufacturing of apple butter,



blackberry, raspberry, strawberry, and currant jams, and in the preparation of mincemeat and other articles in which sirup and sugar may be used.

#### MOLASSES.

The factories of this country are able to make from sugar beets an amount of white granulated sugar equal to from 9 to 12 per cent of the weight of the beets, the amount depending on the sugar content and purity of the beets and the effectiveness of the process. The beets themselves may have contained originally from 12 to 18 per cent of their weight in sugar. Excepting a small percentage which goes off with the pulp, the balance remains in the molasses. No process has ever been devised to extract all this sugar, nor have any satisfactory results ever been secured in dealing with the molasses by-product itself. It is one of the things that has always given the manufacturer of beet sugar trouble. It has an acrid taste. It has been impossible to use beet sugar in the raw or unrefined state on account of the salts of different kinds extracted from the beets along with the sugar. It is necessary to eliminate these salts by a process of refining before the sugar can be used. These salts appear in the molasses in a condensed form, rendering this by-product absolutely useless except as worked up into shoe blacking, vinegar, alcohol, etc. Scientists have been endeavoring since the beginning of the beet-sugar industry to find some way in which these salts may be eliminated, and the sugar contained in the molasses secured, or the molasses converted into pure palatable sirup. The presence of the salts has always thwarted their efforts to extract this sugar.

This molasses can be used in the manufacture of alcohol, but the revenue taxes are so heavy that this has not been undertaken. Good vinegar can be made from molasses, but this is a separate business from sugar making and requires separate organization; it has not been undertaken on any extensive scale as yet. There are a great many uses to which this molasses could be put, providing a business was established to work upon it as raw material. The principal use that is now made of it is to mix it with leaves or pulp for feeding purposes. It is also used to some extent as a fertilizer.

#### BENEFITS TO OTHER INDUSTRIES.

The establishment of a sugar factory not only opens up a large field for the employment of labor, but it opens up a field for the employment of capital. It becomes at once a market for considerable crude material to be used in conducting the business. First and most important, it furnishes a market for the beets. Then the factory is a large consumer of coal, and, as the factories are often established in communities having local coal fields, they become at once local mar-

kets for a local product. The amount of coal necessary to work up a certain amount of beets is generally computed at about 17 per cent by weight, or in case of an ordinary factory of 350 tons capacity, about 60 tons of coal per day, or 6,000 tons for a full campaign of one hundred days. A factory also consumes a large amount of lime rock. Of necessity this must also be a local product. A factory usually consumes lime rock to the extent of about 10 per cent of the crude weight of beets worked, which, in the case of a 350-ton factory would be 35 tons of lime rock per day, or 3,500 tons for the campaign. It consumes about one-fifth as much coke as lime, or a little less than 700 tons during a campaign.

The establishment of a factory in a community necessitates considerable transportation of crude products, beets, coal, and lime rock, to the factory, and of the finished product to the market. It stimulates banking and almost all kinds of mercantile business throughout the community.

#### AGRICULTURAL PROBLEMS.

There are two sides to the proposition of establishing a sugar factory in any particular community: First, that of the farmer involving agricultural conditions; and, second, that of the manufacturer, or those financially interested in the enterprise.

The leading difficulties of the farmer may first be noticed: To begin with, he is unacquainted with the methods of cultivating the sugar-beet plant, and his first experience usually proves unsatisfactory. He is accustomed to certain methods in farming. As a rule he is conservative, and thinks, from his long experience in farming, that he knows how. He undertakes to apply the methods used in the cultivation and production of other crops. He is not inclined to listen to those who are posted in methods applicable to the new crop. Eventually he finds out his mistake. He finds that in growing sugar beets he must apply principles, in many cases, the reverse of those necessary to other crops. For instance, he has been accustomed to growing large ears of corn, large hogs, and large steers; but in the case of sugar beets he finds that the first question is not one of size, but of quality. He must grow beets of a certain size, purity, and sugar content. In order to accomplish this he must give careful attention to the work of preparing the land, planting the seed, bunching, thinning, and cultivating. He finds that attention to details counts in results at the harvest and the profits of this crop. He learns that the whole process is a very laborious and expensive one, entirely unlike anything he has attempted before. To be successful, he must apply the methods of the gardener to a field crop; he must have a rich soil and the proper rain conditions at the proper time. These facts can only be learned through experience.



## FARM LABOR.

The labor problem is important in the cultivation of sugar beets. At certain stages of their growth sugar beets require a considerable amount of labor. This labor is very tiresome. As a rule the farmer, if he grows beets to any extent, does not have on his farm sufficient labor to take care of the work of thinning, bunching, hoeing, and harvesting the sugar beets; nor does any farming community possess to any considerable extent the labor necessary to grow the beets that a factory will require in a campaign. It will cost about \$30 an acre in sections where sugar beets are grown under rain conditions, and about \$40 to \$45 an acre in sections where beets are grown by irrigation, to cover the cost of seed, preparation of seed bed, bunching and thinning, hoeing, cultivating, harvesting, and delivering to the factory. These estimates apply to growing sugar beets when it is done right. In the farming communities of foreign countries, as a rule, a large amount of suitable labor can be secured in the neighborhood, because these neighborhoods are more thickly settled, the whole population is willing to do the laborious, tedious work required, and whole families work at it, including the father, mother, and children. In this country, as a rule, the farmer, his older sons, and hired hands must attend to the outdoor work. It has been found necessary for the sugar-beet growers to resort to the cities and towns for the extra labor required. Most of this work comes about the time the public schools are closed, and boys from 12 years up are used for bunching and thinning the beets, for hoeing them during the season, and to aid in the harvesting, by piling the beets, cleaving the tops, and loading the beets into wagons. In the cities also live many foreigners from Holland, Germany, Russia, Sweden, and other countries, who are thoroughly familiar with this kind of work. These people are willing to move out into the fields and live in tents and make contracts at so much per acre for bunching, thinning, hoeing, weeding, and harvesting. Since the starting of the beet-sugar industry in this country many other foreigners are coming here, knowing that they can secure employment of this kind. While the labor question is a serious one, it is one capable of solution.

## SEED PRODUCTION.

At present most of the seed used in this country for growing sugar beets is imported from Europe. It is quite an item in the expense of production. The rule is to plant 20 pounds per acre, the factory furnishing the seed. It costs the farmer 15 cents per pound, or \$3 per acre. It would seem that this country should not only produce its sugar but the seed for growing the beets.

Seed growing is a very intricate business, and to be successfully

done it requires considerable capital and a great deal of care and skill. For this reason beet-seed production in this country is in its infancy, and only a very small proportion of the seed used is produced here.

Some of the factories are starting seed production in connection with sugar production. The factory at Lehi, Utah, has probably accomplished the most in this direction, but something has been done at Watsonville, Cal., and Rockyford, Colo. I believe some of the factories in Michigan are also starting up this work.

#### METHODS.

Every year the scientific agricultural superintendents for each factory settle certain problems that will have much to do with lowering the cost of beet-sugar production in the future for that particular locality. In this connection may be mentioned some interesting observations I have made during the past year. It is a well-settled conclusion of the beet growers at Leavitt (formerly Ames), Nebr., that land on which corn has been grown the previous year is the best for a beet field. They consider that the cultivation given the corn during its growth has much to do with the growing of sugar beets the following year. In order to plant the beets on corn ground, all stalks and roots must first be removed. This work is quite expensive. The factory at Leavitt has been in operation for three years and it has taken that time to work out this simple problem. The original plan was to plow the ground shallow at first, then go over it with a steel-spring hay rake and collect the stubs and stalks and burn them. What the rake did not secure, laborers had to gather by hand. It has been estimated that it cost about \$3 per acre to accomplish this work. On the farms growing beets for this particular company, the Standard Cattle Company raises its corn, hay, and other forage for feeding purposes. Most of the corn is cut up for fodder. After three years' experience it has been found that they can go over the corn ground with a disk plow in the spring when the frost begins to go out of the ground, and so thoroughly tear up the roots of the stubs that they can readily be turned under out of the way by deep plowing, and that this can be done at 75 cents per acre, reducing the cost of this work 75 per cent.

I was interested in investigating some of the methods used at Rockyford, Colo. At this place it was found that the beet crop does best when it follows alfalfa. In Nebraska, and most places where alfalfa grows, it is only necessary to plow the crop under. Thus the land gets the benefit of the green crop as fertilizer. But the farm superintendent at Rockyford insisted that this could not be done there because, if the alfalfa were plowed under, every joint and root would grow, and the beet field would look more like an alfalfa field than anything else. It is necessary there, before these alfalfa lands can be used for planting beets, to actually remove from the ground both the tops and roots of the alfalfa plants.



These illustrations serve to show some of the problems that have to be worked out on the farms before the best results can be reached.

#### IRRIGATION.

Measures are now being considered before Congress to more completely develop the irrigation resources of the nation. The supply of irrigation water is now secured almost entirely by tapping the running streams during the growing season. In the case of heavy rainfall, or when the snow melts in the mountains, much more water could be secured if stored and let down gradually through irrigating ditches when the crop needs it. At present much of this water runs to waste. The present consideration by Congress is to devise a plan by which permanent storage reservoirs may be constructed, into which may be conducted the drainage from certain watersheds. This requires a careful and complete system of engineering. If it is accomplished it will very much extend the area of land that can be utilized for growing crops, especially for sugar beets, which have shown a remarkable adaptability for growth under irrigation. When the application of irrigation shall be permanently understood, the irrigated districts will certainly be the ideal sugar-producing sections. Much has yet to be learned on this subject, but there is an opportunity for gradually decreasing the cost of production.

#### CONTROL OF INSECT PESTS AND FUNGUS DISEASES.

Sugar-beet crops have already felt the effects of insect pests and diseases peculiar to the plant. Up to date we have been practically at the mercy of these enemies when their attacks occur. The Department of Agriculture and scientists of the various experimental stations throughout the country have been giving these subjects careful attention, studying like occurrences in Europe and the remedies, preventives, and methods used to meet these enemies; and eventually their efforts will no doubt be successful to a great extent.

#### PROBLEMS FOR THE MANUFACTURER.

The manufacturer or the capitalist who builds a factory finds that he has even more problems to work out than the farmer, and, like the farmer, he usually discovers that he is entering a field that is entirely new to him.

#### NECESSARY INVESTIGATIONS.

Before establishing his plant the prospective manufacturer must thoroughly investigate certain conditions: (1) The water supply. He must have an abundant supply of pure water for the use of the factory. (2) The fuel supply. The factory must be located in a section where cheap fuel can be secured. The fuel used is usually coal, but on the

Pacific coast petroleum is used to a large extent, and in some of the mountain States it is found that wood is the cheapest fuel. (3) The market for the products. (4) The matter of transportation. This should be thoroughly canvassed and settled prior to establishing the factory. The fact that it is proposed to establish a factory on a particular line of railroad can generally be used as a lever to secure, by contract, low freight rates for the future, both in shipping beets and the finished product—sugar. (5) The supply of lime. The local quarries of lime rock must be investigated to see if the quality is suitable and the supply sufficient, as a large amount will be required.

The general conditions having been found satisfactory and the factory being built, other problems arise. In the beginning only a limited amount of skilled labor is employed. Eventually every employee of the factory will become skilled in his particular part. After two or three campaigns have passed the factory has worked out the details of producing the best product at the cheapest cost with the machinery which it has. When this point shall have been reached those interested will be prepared to estimate the cost of production of beet sugar. The difference in cost of production at a new factory and at one operated for a considerable time is much greater than one unacquainted with the subject would suppose.

#### CRUDE MATERIALS.

Each factory must resort to the cheapest fuel available and suitable for its use. There is a vast difference in the grades of coal used by the various factories. Coal, however, is not the only fuel used. On the Pacific coast it is supplanted by petroleum, a product of southern California. At La Grande, Oreg., and to some extent at Waverly, Wash., wood is used.

Attention is directed to the tables (pp. 35–36) compiled from data furnished by the factories themselves covering the various materials used by them during the past year. The amount of coal on an average is shown to be 19.9 per cent of the amount of beets. This is a very high rate when compared with the amount of coal used in the older beet-sugar producing countries. There is an opportunity for economizing in the future.

The same tables show that, in amount of limestone used in the various factories, there is a wide difference. It is evident that some of the factories have not been able to secure the best limestone, or that they have not been able to economize in its use.

There is also quite a difference in the cost of a ton of coke to the various factories. Considerable is imported. Coke production in this country is confined largely to the East, but as new coal regions are discovered the coke industry will probably be extended, the facilities for securing this material will be improved, and it will become cheaper.



## AMERICAN-MADE MACHINERY AND IMPLEMENTS.

The machinery placed in the original factories in this country was largely imported. Since that time our machine shops have taken hold of the matter, and we are now able to entirely equip a factory with American-made machinery. In addition to this, American designers have been working upon the improvement of this machinery and have done a great deal to introduce improvements for cheapening and shortening the work.

We began the industry of growing sugar beets with cumbersome implements imported from Europe. No sooner did the cultivation of this crop reach a considerable extent than did the implement dealers begin the improvement of the implements used. Much progress has been made in this direction. The objects aimed at have been to make the machinery less cumbersome, and to invent new and cheaper appliances for use in seeding, cultivating, and harvesting, so as to economize in horse power and human labor.

## EDUCATION OF LABOR.

Every new factory starts with a few men educated in sugar making. Work in the factory will eventually educate all the employees. As long as the number of factories is rapidly increasing it will be necessary to employ considerable inexperienced help. When the industry shall have reached a later and fuller stage of development this necessity will largely disappear, and each factory will be operated throughout with men thoroughly posted in the work they have to do.

## ATTITUDE OF THE PUBLIC.

The sugar industry, like everything else, is dependent to a considerable degree upon the sympathy manifested by the public. Beet sugar has had to meet the disadvantage of public prejudice. In the beginning the idea was quite prevalent that beet sugar was inferior to cane sugar. The term cane sugar was confused with imported sugar. People appeared to have the idea that all sugar brought into this country was made from cane, while, as a matter of fact, a large portion of it was beet sugar imported from Europe. It was not uncommon for people to call for cane sugar at the stores, or at least to insist upon paying less for the home product made from beets. If beet sugar is properly made there can be no difference. Experts find none. Yet, at the present time, home-made beet sugar is placed at a disadvantage in having to enter the market at 10 cents per hundredweight less than cane or imported sugar. As with all other prejudices, it will take time to overcome this. In this discrimination is involved not only a pecuniary loss to the beet-sugar producers, but a restriction of the market. As the industry grows, it may be confidently expected that this feeling will entirely disappear. A community of interests will operate to make home-made sugar popular.

## THE QUALITY OF THE BEETS.

In the process of making sugar, what are known as the impurities in the beets operates to prevent the extraction of the sugar. It costs a great deal less to secure the sugar from a ton of beets high in purity than from a ton of beets low in purity. Not only is less sugar secured, but it costs a great deal more to secure what is obtained. As sugar-beet growing proceeds in a district, there is generally a gradual increase in the purity and sugar content of the beets, because the farmers learn to grow the crop more successfully. The cost of production is materially reduced when the farmer is able to grow a crop of good quality and high purity. Judging from the experience of other countries, we should be able, in twenty years, to produce beet sugar at one-half the present cost.

## FACTORY OWNERSHIP OF LAND.

There are several projects well organized and capitalized that have plans for developing a lot of new land under new irrigating ditches, and tapping new sources of water supply. The plan is to locate several sugar factories in a series at different points along one system of irrigation. I have personally examined the plan for one project of this kind capitalized for \$3,000,000, and the scheme appears perfectly feasible. This enterprise foreshadows the tendency of beet-sugar development in the arid region. In organizing such a beet-sugar enterprise the first problem for the promoters is how to secure a supply of beets. The territory is unsettled. The enterprise comprehends not only the building and equipment of a factory, but the securing of an adequate and certain supply of sugar beets. This naturally leads the promoters to conclude that the manufacturing company itself should own or control sufficient land to furnish the supply of beets. The present tendency of beet-sugar production under these circumstances involves not only the establishment of factories, but the purchase of sufficient land to furnish the raw material. This tendency is so strong, and of so much importance, that I feel the necessity of calling especial attention to it. It grows out of the natural conditions that exist. This method of procedure is directly opposite to that which obtains in the Mississippi Valley, or in the older agricultural States farther east, where the farmer furnishes the beets and the manufacturer confines himself to producing the sugar. In these sections there will always be two interests involved—one that is strictly agricultural and the other strictly manufactural. But the system of development in the arid region unites both interests in the manufacturer and eliminates the independent farmer.

## EDUCATIONAL FORCES AT WORK.

There are various forces at work educating the people at large, and especially the farmers and factory people, in the production of sugar



beets and the manufacture of sugar. These forces deserve special attention, because it is through their influence that the various mistakes, leaks, and losses are eliminated and the cost of production reduced.

#### THE PRESS.

The press may always be considered as the advance agent of progress. It has been a very active agent in the establishment of the sugar-beet industry. No sooner does any State or section begin the preliminary investigations of this subject than writers for the public press begin to investigate and to disseminate information pertaining thereto. Many times this work is crude, but in the end it educates the press itself as well as the public. When these efforts have materialized into the actual establishment of a sugar factory, papers of another class take up the work, namely, the agricultural papers, or in some cases special papers devoting their attention to the sugar industry. Such special papers are now published in Pennsylvania, Illinois, Michigan, Colorado, and California. Papers of this class carry the work along, developing with the progress of the industry itself. Their attention is not only devoted to the farmer and everything that has to do with his side of the work, but to the work of the factory itself.

#### PUBLIC MEETINGS.

Another factor in the education of the people in sugar production is the convention. With the first talk of a factory the farmers are called together and the benefits of the sugar industry are outlined. Public speakers discuss the relation of the industry to the farmers and to the business elements of the community. Steps are inaugurated to test the conditions for growing sugar beets and to interest capital in establishing a factory provided the results are favorable.

The next step in the development of the convention work is the calling of a meeting, in which the various sections of a district or State are represented by local delegates, to consider the larger questions involved. Experts versed in the agricultural side of the problem and others versed in the factory side address these meetings, and in this way a general interest in the sugar industry is aroused. The convention idea develops from the local to the general.

#### ACTUAL EXPERIENCE.

When a factory has been established actual experience in raising beets and making sugar completes the education of all concerned. The work becomes practical as well as theoretical. Farmers learn exactly what it costs to grow sugar beets. They learn about the production of the crop, the labor involved, the profits obtained, and the incidental benefits in the improvement of land, stock feeding, and the like. Manufacturers know what they can accomplish in the pro-



duction of sugar, the cost and the profits of the sugar factory. Business men discover what their relations are to the industry and the laborer learns its resources of employment. The coal dealers, quarrymen, transportation companies, coke dealers, and furnishers of all kinds of supplies for the factory are advised of their status in this new industry.

#### BEET-SUGAR FACTORIES OF THE UNITED STATES.

The recent census shows the rapid growth of the beet-sugar industry in this country. Thirty-one factories had been established before the end of the century. Since that time eleven other factories have been put in operation, located at the following places, and having the daily capacities named: Lyons, N. Y., 600 tons; Loveland, Colo., 1,000 tons; Rockyford, Colo., 1,000 tons; Sugar City, Colo., 500 tons; Bingham Canyon, Utah, 350 tons; Provo, Utah, 350 tons; Logan, Colo., 400 tons; Lansing, Mich., 600 tons; Saginaw, Mich., 600 tons; Salzburg, Mich., 400 tons; Menomonee Falls, Wis., 500 tons.

At the following places factories are either in process of erection or preparations have been made for building in 1902: Sebewaing, Mich., 600 tons; Carrollton, Mich., 600 tons; Mount Clemens, Mich., 600 tons; Croswell, Mich., 600 tons; Greeley, Colo., 800 tons; Eaton, Colo., 500 tons; Fort Collins, Colo., 500 tons.

In the following table is given a list of the beet-sugar factories in the United States, with their location and capacities:

*Beet-sugar factories of the United States.*

State, and name of company.	Location.	Daily capacity.
MICHIGAN.		<i>Tons of beets.</i>
Michigan Sugar Co .....	Bay City .....	500
Bay City Sugar Co .....	do .....	600
Detroit Sugar Co .....	Rochester .....	500
Wolverine Sugar Co .....	Benton Harbor .....	350
Peninsular Sugar Refining Co .....	Caro .....	600
West Bay City Sugar Co .....	West Bay City .....	750
Alma Sugar Co .....	Alma .....	600
Holland Sugar Co .....	Holland .....	350
Kalamazoo Sugar Co .....	Kalamazoo .....	500
Marine Sugar Co .....	Marine City .....	350
Lansing Sugar Co .....	Lansing .....	600
Saginaw Sugar Co .....	Saginaw .....	600
German-American Cooperative Beet Sugar Co .....	Salzburg .....	400
Sebewaing Sugar Co .....	Sebewaing* .....	600
Valley Sugar Co .....	Carrollton* .....	600
Macomb Sugar Co .....	Mount Clemens* .....	600
Croswell Sugar Co .....	Croswell* .....	600
NEW YORK.		
Binghamton Beet Sugar Co .....	Binghamton .....	600
Empire State Sugar Co .....	Lyons .....	600
COLORADO.		
American Beet Sugar Co .....	Rockyford .....	1,000
Colorado Sugar Manufacturing Co .....	Grand Junction .....	350

\* Factories in process of construction.

*Beet-sugar factories of the United States—Continued.*

State, and name of company.	Location.	Daily capacity.
COLORADO—continued.		<i>Tons of beets.</i>
National Sugar Manufacturing Co.....	Sugar City.....	500
Western Construction Co.....	Loveland.....	1,000
Greeley Sugar Co.....	Greeley *.....	800
.....	Eaton *.....	500
.....	Fort Collins *.....	500
UTAH.		
Ogden Sugar Co.....	Ogden.....	350
Utah Sugar Co.....	Lehi.....	350
Utah Sugar Co. (Raspings Station).....	Springville.....	350
Do.....	Bingham Canyon.....	350
Do.....	Provo.....	350
Logan Sugar Co.....	Logan.....	400
NEBRASKA.		
American Beet Sugar Co.....	Grand Island.....	350
Do.....	Norfolk.....	350
Standard Beet Sugar Co.....	Leavitt (Ames).....	500
CALIFORNIA.		
Alameda Sugar Co.....	Alvarado.....	800
Los Alamitos Sugar Co.....	Watsonville.....	1,000
California Beet Sugar and Refining Co.....	Los Alamitos.....	700
Speckels Sugar Co.....	Chino.....	1,000
Do.....	Crockett.....	1,200
American Beet Sugar Co.....	Salinas.....	3,000
Do.....	Oxnard.....	2,000
Union Sugar Co.....	Betteravia.....	500
OTHER STATES.		
Minnesota Sugar Co.....	St. Louis Park, Minn.....	350
Continental Sugar Co.....	Fremont, Ohio.....	350
Wisconsin Sugar Co.....	Menomonee Falls, Wis.....	500
Pecos Valley Beet Sugar Co.....	Carlsbad, N. Mex.....	200
Washington State Sugar Co.....	Waverly, Wash.....	350
Oregon Sugar Co.....	Lagrande, Oreg.....	350

\* Factories in process of construction.

## PROPOSED NEW FACTORIES.

Below is given a list showing location, daily capacity, and estimated cost of construction and equipment of the beet-sugar projects now under contemplation. These projects are in different stages of discussion, organization, and capitalization. Some concerns are fully organized and capitalized; in other cases conditions have been canvassed, and organization seems probable. Nearly all these projects are likely to materialize in the future, provided questions affecting the beet-sugar industry are settled.

This list includes only such projects as came to my attention during my investigations of the past year, and is authentic as far as it goes. There are doubtless others of which I have no definite information. To install these factories would require an investment of \$49,000,000. In addition, they would require annually a working capital of \$9,080,000. They could purchase from the farmers, annually, beets to the amount of \$14,700, besides a great many other crude materials, and would employ a large number of laborers.

*List of proposed factories.*

Location.	Nominal daily capacity.	Cost of construction and equipment.
<b>ARIZONA.</b>		
Phoenix .....	<i>Tons of beets.</i> 1,000	\$1,000,000
Glendale.....	500	500,000
<b>CALIFORNIA.</b>		
Hemet .....	500	500,000
Hueneme .....	500	500,000
Anderson .....	1,000	1,000,000
Tehama .....	500	500,000
Los Angeles.....	1,000	1,000,000
<b>COLORADO.</b>		
Fowler.....	500	500,000
Denver.....	500	500,000
Fort Collins.....	1,000	1,000,000
Arveda.....	500	500,000
Prowers County .....	1,000	1,000,000
Longmont .....	1,000	1,000,000
Amity.....	500	500,000
<b>INDIANA.</b>		
Shelby .....	1,000	1,000,000
<b>IOWA.</b>		
Mason City .....	500	500,000
Missouri Valley .....	1,000	1,000,000
Toledo .....	500	500,000
Storm Lake .....	500	500,000
Fort Dodge .....	500	500,000
California Junction .....	500	500,000
<b>IDAHO.</b>		
American Falls .....	500	500,000
<b>MICHIGAN.</b>		
Port Huron .....	500	500,000
Chippewa County .....	500	500,000
Racine .....	500	500,000
Grand Rapids .....	800	800,000
Lapeer .....	500	500,000
Port Austin .....	500	500,000
Green Bay .....	500	500,000
Dundee .....	750	750,000
Caseville.....	650	650,000
Monroe .....	600	600,000
Saginaw .....	500	500,000
Owosso.....	500	500,000
Chesaning .....	500	500,000
Grand Rapids .....	350	350,000
Croswell .....	700	700,000
Monroe .....	800	800,000
Howell.....	500	500,000
Fowlerville .....	500	500,000
Cass City .....	500	500,000
Mount Pleasant.....	500	500,000
Omer .....	500	500,000
St. Louis .....	500	500,000
Mason .....	500	500,000
Pinconning .....	500	500,000
Charlevoix .....	350	350,000
Pontiac .....	500	500,000
Ann Arbor.....	400	400,000
St. Johns.....	500	500,000
<b>MINNESOTA.</b>		
Denmark .....	500	500,000
Little Falls .....	400	400,000
Newburg .....	500	500,000
Winona .....	500	500,000
Crookston.....	500	500,000
<b>MONTANA.</b>		
Hamilton .....	500	500,000
<b>NEW YORK.</b>		
Wellsville.....	500	500,000
Rochester.....	1,000	1,000,000



*List of proposed factories—Continued.*

Location.	Nominal daily ca- pacity.	Cost of con- struction and equipment.
<b>NEW JERSEY.</b>		
Mount Morris .....	<i>Tons of beets.</i> 500	\$500,000
<b>NORTH DAKOTA.</b>		
Oaks .....	500	500,000
Fargo .....	500	500,000
<b>OHIO.</b>		
Toledo .....	500	500,000
Sandusky .....	500	500,000
Norwalk .....	350	350,000
<b>OREGON.</b>		
Portland .....	500	500,000
<b>PENNSYLVANIA.</b>		
Shawmut .....	500	500,000
<b>SOUTH DAKOTA.</b>		
Aberdeen .....	500	500,000
Kimball .....	500	500,000
<b>UTAH.</b>		
Uintah .....	1,000	1,000,000
Bear River Valley .....	1,000	1,000,000
Gunnison .....	500	500,000
<b>WISCONSIN.</b>		
Sheboygan .....	350	350,000
Racine (4 plants) .....	500	2,000,000
Oconomowoc .....	500	500,000
Waupaca .....	500	500,000
Watertown .....	500	500,000
Stephens Point .....	500	500,000
Beaver Dam .....	500	500,000
Burlington .....	500	500,000
Franksville .....	500	500,000
Kaukauna .....	500	500,000
<b>WYOMING.</b>		
Wheatland .....	500	500,000
Cheyenne .....	1,000	1,000,000
Total .....		49,000,000

## STATISTICS OF THE INDUSTRY IN THE UNITED STATES.

The statistics of factory development, consumption, production, and importation of sugar, etc., have been drawn from the most reliable sources.

## THE CENSUS REPORTS.

From Bulletin No. 59 of the Twelfth Census are taken the following tables, which show the growth of the beet-sugar industry in this country during the last two decades:

*Number and nominal daily capacity of establishments in 1900, 1899, and 1898.*

States and Territories.	1900.		1899.		1898.	
	Number of establishments.	Nominal daily capacity in tons of beets.	Number of establishments.	Nominal daily capacity in tons of beets.	Number of establishments.	Nominal daily capacity in tons of beets.
The United States .....	<sup>a</sup> 37	22,310	<sup>b</sup> 31	19,110	15	7,560
California .....	8	9,900	<sup>b</sup> 8	9,900	5	4,400
Colorado .....	3	1,850	1	350	.....	.....
Illinois .....	1	700	1	700	.....	.....
Michigan .....	10	4,450	9	4,100	1	440
Minnesota .....	1	400	1	400	1	400
Nebraska .....	3	1,260	3	1,260	2	660
New Mexico .....	1	200	1	200	1	200
New York .....	3	1,000	2	400	2	400
Ohio .....	1	400	.....	.....	.....	.....
Oregon .....	1	350	1	350	1	350
Utah .....	4	<sup>c</sup> 1,450	3	<sup>d</sup> 1,100	2	750
Washington .....	1	350	1	350	.....	.....

<sup>a</sup> Includes 2 idle establishments.

<sup>b</sup> Includes 1 idle establishment.

<sup>c</sup> Includes 2 auxiliary factories, at which no sugar is manufactured, but juice is extracted from the beets and pumped to a central factory for treatment.

<sup>d</sup> Includes 1 auxiliary factory.

*Statistics of beet-sugar factories in 1879, by States, census of 1890. <sup>a</sup>*

States.	Number of establishments.	Capital invested.	Average number of wage earners. <sup>b</sup>	Wages paid.	Cost of materials used.	Value of products.
The United States .....	4	\$365,000	350	\$62,271	\$186,128	\$282,572
California .....	2	215,000	150	39,131	104,724	162,988
Delaware .....	1	100,000	50	3,140	6,404	8,584
Maine .....	1	50,000	150	20,000	75,000	111,000

<sup>a</sup> Data from Tenth Census, Manufactures, pp. 94, 101, and 127.

<sup>b</sup> Men, 16 years old and over.

#### PRODUCTION OF SUGAR IN THE UNITED STATES.

The table below shows the yearly production of cane and beet sugar in the United States for the last twenty-one years. Unfortunately, all of the cane-sugar production is put under the head of Louisiana, but, as a matter of fact, Texas is producing a limited amount of this sugar, having produced 3,238 tons during 1901.

The following further facts can be noted: Beet-sugar production has practically developed in the last thirteen years. The increase in 1901 over 1900 is 140 per cent. In twenty-one years the production of cane sugar has increased 155.11 per cent. The present amount of beet sugar produced is 59.34 per cent of the cane-sugar product.

*Production of beet and cane sugar in the United States (according to Willett & Gray, New York City).*

Years.	Beet.	Cane (Louisiana).	Total.
	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>
1880-81.....	(a)	122,000	122,000
1881-82.....	(a)	71,000	71,000
1882-83.....	(a)	136,000	136,000
1883-84.....	(a)	128,000	128,000
1884-85.....	(a)	94,000	94,000
1885-86.....	(a)	128,000	128,000
1886-87.....	(a)	81,000	81,000
1887-88.....	(a)	158,000	158,000
1888-89.....	2,000	145,000	147,000
1889-90.....	3,000	128,000	131,000
1890-91.....	3,000	216,000	219,000
1891-92.....	5,000	161,000	166,000
1892-93.....	12,000	202,000	214,000
1893-94.....	20,000	266,000	286,000
1894-95.....	20,000	317,000	337,000
1895-96.....	29,000	238,000	267,000
1896-97.....	38,000	282,000	320,000
1897-98.....	40,000	310,000	350,000
1898-99.....	32,000	216,000	278,000
1899-1900.....	73,000	132,000	205,000
1900-1901.....	77,000	275,000	352,000
1901-2 <sup>b</sup> .....	184,606	311,238	495,951

<sup>a</sup> Less than 1,000 tons.

<sup>b</sup> Figures for 1901 inserted by Charles F. Saylor, special agent.

The following tables show the production of sugar during recent years in the United States and its insular dependencies:

*Production of sugar in the United States for the four years 1898-99 to 1901-2.*

	1898-99. <sup>a</sup>	1899-1900. <sup>a</sup>	1900-1901. <sup>a</sup>	1901-2. <sup>b</sup>
	<i>Tons.<sup>c</sup></i>	<i>Tons.<sup>c</sup></i>	<i>Tons.<sup>c</sup></i>	<i>Tons.</i>
Beet sugar.....	32,000	73,000	77,000	184,713
Cane sugar (Louisiana).....	246,000	132,000	275,000	311,238
Total sugar.....	278,000	205,000	352,000	495,951

<sup>a</sup> The statistics given in the first three columns are on the authority of Willett & Gray, New York City.

<sup>b</sup> The figures in the last column were compiled by C. F. Saylor, special agent.

<sup>c</sup> Long tons (2,240 pounds).

*Production of cane sugar in United States dependencies for the four years 1898-99 to 1901-2.*

	1898-99. <sup>a</sup>	1899-1900. <sup>a</sup>	1900-1901. <sup>a</sup>	1901-2. <sup>b</sup>
	<i>Tons.<sup>c</sup></i>	<i>Tons.<sup>c</sup></i>	<i>Tons.<sup>c</sup></i>	<i>Tons.</i>
Hawaii.....	253,000	259,000	321,000	350,000
Porto Rico.....	54,000	35,000	80,000	92,000
Philippines.....	93,000	63,000	52,000	75,000
Total United States dependencies.....	400,000	357,000	453,000	517,000

<sup>a</sup> The statistics given in the first three columns are on the authority of Messrs. Willett & Gray, New York City.

<sup>b</sup> The figures in the last column were compiled by C. F. Saylor, special agent

<sup>c</sup> Long tons (2,240 pounds).

#### IMPORTATION OF SUGAR INTO THE UNITED STATES.

Below are given the total imports of sugar from all countries into the United States for a series of years from 1881 to 1901, inclusive. This covers a period of twenty-one years and shows a gradual progres-



sive growth of trade in this product between this country and the various countries supplying it. In this period the total imports of sugar have increased 147 per cent in amount and 41.4 per cent in value.

*Imports (general) of sugar into the United States, 1881-1901.*

Years ended June 30—	Pounds.	Tons.	Value.
1881.....	1,946,865,165	869,136	\$86,670,624
1882.....	1,990,449,609	888,593	90,439,675
1883.....	2,137,819,123	954,383	91,637,992
1884.....	2,756,416,896	1,230,543	98,262,607
1885.....	2,717,884,653	1,213,341	72,519,514
1886.....	2,689,881,765	1,200,840	80,773,744
1887.....	3,136,443,240	1,400,197	78,411,224
1888.....	2,700,284,282	1,205,484	74,245,206
1889.....	2,762,202,967	1,233,126	88,543,971
1890.....	2,934,011,560	1,309,826	96,094,532
1891.....	3,433,477,222	1,555,123	105,728,216
1892.....	3,556,509,165	1,587,727	104,408,813
1893.....	3,766,445,347	1,681,448	116,255,784
1894.....	4,345,193,881	1,939,818	126,871,889
1895.....	3,574,510,454	1,595,763	76,462,836
1896.....	3,896,338,557	1,739,436	89,219,773
1897.....	4,918,905,733	2,195,940	99,066,181
1898.....	2,689,920,851	1,200,857	60,472,749
1899.....	3,980,250,569	1,776,897	94,964,120
1900.....	4,018,086,530	1,793,788	100,250,974
1901*.....	4,808,661,124	2,146,724	122,506,589

\*Including imports from Hawaii and Porto Rico, as in previous years.

CONSUMPTION OF SUGAR IN THE UNITED STATES.

The following table shows for each year, during the past twenty-one years, the consumption of sugar, the yearly increase of consumption, and the per capita consumption for each year. The consumption has practically doubled in the last eighteen years, and in the entire period it has increased 138.77 per cent. This per cent of increase divided by the number of years in the period gives 6.94 as the average annual per cent of increase.

This rate is sometimes used as a factor in estimating future consumption. But this can not be properly done unless the figures for consumption for 1881 are used as the basis. If the figures for a particular year (1901, for instance) are used as a basis for estimating the consumption for the following year (1902) the results will be incorrect, being considerably too large. A great many have made a misuse of this per cent of annual increase of consumption.

Mr. Frank H. Hitchcock, chief of the Section of Foreign Markets, United States Department of Agriculture, was asked by me to derive the true factor for computing consumption from year to year, and in response to my request, he derived the factor 4.45 per cent for computing our consumption of sugar for 1902 from that of 1901. Mr. Hitchcock's communication, with the formula, follows:

U. S. DEPARTMENT OF AGRICULTURE,

SECTION OF FOREIGN MARKETS,

Washington, D. C., February 17, 1902.

DEAR SIR: In reference to your inquiry of Saturday, the 15th instant, as to an average annual rate to be used in estimating the probable future consumption of sugar in the United States, I would suggest 4.45 per cent.

I have arrived at this rate by taking the consumption figures for the first and last years of the period 1881-1901 and employing the usual algebraic formula for compounding, viz:

$$A = P \times (1 + r)^n$$

from which we derive as the formula for obtaining the rate—

$$r = \sqrt[n]{\frac{A}{P}} - 1$$

$r$  = Average annual rate of increase.

$n$  = Number of years.

$P$  = Amount for first year of period.

$A$  = Amount for last year of period.

Taking the period 1881-1901, for the first year of which, according to Willett & Gray, the actual consumption was 993,532 tons, and for the last year of which, according to the same authority, the actual consumption was 2,372,316 tons, and applying the above formula, there being twenty years from the first to the last year of the period, we obtain the following:

$$r = \sqrt[20]{\frac{2,372,316}{993,532}} - 1 = 0.0444786 = 4.44786 \text{ per cent, or about 4.45 per cent.}$$

This rate of increase differs materially from that given by Messrs. Willett & Gray, of New York City, for the twenty years subsequent to 1881. Apparently Willett & Gray merely compared the consumption of 1881 with that of 1901, and finding the percentage of increase in the latter year over the former amounted to 138.77 per cent, they divided by 20, the number of years in the period of increase, to ascertain the annual average rate of increase for that period, and obtained a rate of 6.94 per cent. In estimating future consumption, however, an average rate obtained after Willett & Gray's method could hardly be considered accurate.

Very truly, yours,

FRANK H. HITCHCOCK.

Mr. C. F. SAYLOR,

*Special Agent, Department of Agriculture.*

*Consumption of sugar in the United States, 1881-1901.*

[According to Willett & Gray.]

Year.	Total amount of sugar consumed.	Increase (+) or decrease (-). <sup>a</sup>	Consump- tion per capita.
	Tons. <sup>b</sup>	Per cent.	Pounds.
1881.....	993,532		
1882.....	1,061,220	+ 6.80	
1883.....	1,170,375	+10.30	
1884.....	1,252,366	+ 7.00	51.00
1885.....	1,254,116	+ 0.14	49.95
1886.....	1,355,809	+ 8.11	52.55
1887.....	1,392,909	+ 2.73	53.11
1888.....	1,457,264	+ 4.62	54.23
1889.....	1,439,701	- 1.21	52.64
1890.....	1,522,731	+ 5.80	54.56
1891.....	1,872,400	+22.96	67.46
1892.....	1,853,370	- 1.10	63.76
1893.....	1,935,862	+ 2.83	63.83
1894.....	2,012,714	+ 5.08	66.64
1895.....	1,949,744	- 3.27	64.23
1896.....	1,940,086	- 0.53	60.9
1897.....	2,070,978	+ 6.79	63.5
1898.....	2,002,902	- 3.29	60.3
1899.....	2,078,068	+ 3.75	61.0
1900.....	2,219,847	+ 6.82	66.6
1901 <sup>c</sup> .....	2,372,000	+ 6.85	68.4

<sup>a</sup> As compared with the previous year.

<sup>b</sup> Tons of 2,240 pounds.

<sup>c</sup> The figures for 1901 have been inserted by Charles F. Saylor, special agent.

The rapid growth in consumption of sugar may strike one at first as hard to understand, but a closer investigation reveals that it is one of the natural results of the rapid development that characterizes all the industries of this country. Not only is sugar used as an article of diet, but it is required in large quantities in the manufactures, arts, and sciences, this being the principal cause of the growth of consumption. While it is a fact that the daily table use of this article grows as wealth accumulates, this would not by any means account for the large increase in consumption. Throughout the whole country, especially in the mountain and Western States, we have been rapidly developing very productive fruit districts. Irrigation has played an important part in extending the fruit industry. These orchards and patches of small fruits have been coming gradually into production. Many of them are distant from the markets. Their products are of a perishable nature, and can not be distributed to consumers in a fresh state. Canning industries and preserving industries of all kinds have been installed to work up these products. Sugar is required in large amounts in preserving and canning fruits. Like other industries, the prepared-fruit industry has to find a market. It has accomplished this, not only at home, but to some extent in foreign countries. Each year sees a large increase in the supply of fruit that must be treated in this way, and each year has seen a consequently large growth in our home and foreign trade in these products. Naturally the increase in the demand for sugar in this direction has been enormous; yet the fruit industry is only in its infancy.

#### FACTORY RESULTS FOR 1901.

The following table is made up from data reported to me by the various factories of the United States, covering their actual work during the past year. The figures entering into the tables represent actual returns, with the following exceptions:

First. Two factories did not respond to my request for data. In those instances estimates were made from other information at hand.

Second. Four or five factories failed to fill out a few of the blanks in their replies, and in order to make the table complete throughout, estimates were made from other information at hand and by comparison with the results of other factories.

Third. As it is not desirable to disclose the identity of the factories, each factory is indicated by a number.

The second table is made up of data derived from the first, and gives a very complete and interesting exposition of the results obtained by the sugar factories of this country in their actual work.



Results of factory operations in the United States, campaign of 1901.

Factory number.	Acres of beets harvested.	Quantity of beets worked.	Sugar in the beet.	Coefficient of purity.	Quantity of sugar produced.			Amount of fuel used.			Factory laborers.			Season opened.	Season closed.	Length of campaign.	Crop conditions.
					Pounds.	Tons.		Coal.	Oil.	Wood.	Num-ber.	Daily wages.	Total wages.				
		Tons.	Per cent.					Tons.	Barrels.	Cords.			Tons.			Days.	
1.....	3,200	25,200	13.8	82	5,000,000	2,500		3,707			178	\$1.48	\$19,212	Nov. 5	Jan. 17	73	Fair.
2.....	3,200	21,400	13.6	84.9	4,337,983	2,169		4,226			155	1.50	15,578	Oct. 16	Dec. 22	67	Do.
3.....	2,793	12,300	12.7	76.2	2,492,000	1,246		3,300			160	1.92	20,000	Oct. 14	Dec. 18	65	Poor.
4.....	1,800	65,000	14.8	83	11,200,000	7,100		13,000			275	1.88	62,040	Oct. 1	Jan. 28	120	Fair.
5.....	7,100	40,000	14.6	82.3	8,200,000	4,100		10,000			175	1.80	38,745	Oct. 1	Feb. 1	123	Average.
6.....	4,600	61,000	14.2	84	13,750,000	6,875		10,350			275	2.00	60,500	Oct. 3	Jan. 20	110	Fair.
7.....	830	9,841.8	12.6	73.5	1,771,500	885.7		1,600			128	1.75	60,500	Oct. 3	Jan. 20	110	Fair.
8.....	6,000	53,000	14.3	83.1	11,660,000	5,830		10,000			270	1.87	59,073	Oct. 5	Jan. 30	82	Good.
9.....	3,000	28,789	13.6	86.6	5,800,000	2,900		4,100			210	1.85	20,000	Oct. 10	Jan. 8	90	Fair.
10.....	4,200	31,600	14.5	84	6,621,000	3,312		6,300			270	1.99	32,164	Oct. 16	Jan. 15	88	Do.
11.....	6,000	43,500	14.4	82.5	8,100,000	4,050		9,000			275	1.90	46,000	Oct. 19	Jan. 15	98	Poor.
12.....	3,619	26,134.5	13.5	82.5	4,962,000	2,481		7,500			275	2.00	53,900	Oct. 26	Feb. 1	81	Fair.
13.....	3,110	28,000	14.5	83	7,000,000	3,500		5,600			250	2.08	50,000	Oct. 28	Feb. 1	96	Average.
14.....	5,200	45,000	14.5	83	9,000,000	4,500		5,600			220	1.75	21,175	Jan. 18	Mar. 13	55	Do.
15.....	3,300	22,000	14	82	4,400,000	2,200		4,500			275	1.88	51,183	Sept. 30	Jan. 20	80	Poor.
16.....	6,000	54,000	14.5	82.5	10,800,000	5,400		10,800			220	2.16	38,016	Nov. 1	Jan. 20	80	Good.
17.....	2,470	18,245	14.8	82.3	3,466,550	1,733.3		3,101			300	2.11	36,000	Sept. 24	Dec. 25	57	
18.....	3,200	28,000	14	81	5,400,000	2,700		8,950			225	1.83	35,844	Oct. 7	Jan. 2	87	Poor.
19 <sup>a</sup>	3,200	32,125.3	14.2	82.2	7,001,000	3,500.5		8,000			250	1.97	38,000	Sept. 21	Dec. 7	77	Fair.
20.....	4,717	37,985	12.6	76.5	7,911,300	3,955.7		7,006			250	2.00	50,000	Oct. 28	Mar. 31	111	Poor.
21.....	5,000	64,650	15.7	80	14,224,000	7,112		16,162			200	2.13	54,528	Oct. 2	Jan. 18	108	Good.
22.....	9,969	93,559	17	82.2	21,247,600	12,123.8		19,950			450	2.35	114,086	Oct. 2	Jan. 18	108	Fair.
23.....	3,100	30,420	17.5	85	7,900,000	3,950		6,000			180	2.23	30,150	Oct. 6	Dec. 20	75	Do.
24.....	7,000	78,500	15.2	84	18,350,000	9,175		11,000			275	2.00	45,100	Sept. 25	Dec. 16	82	Good.
25.....	3,206	41,461	13	82	8,000,000	4,000		6,100			132	1.80	28,037	Sept. 14	Jan. 9	118	Fair.
26.....	2,300	23,305	13.8	82.6	4,360,000	2,180		3,902			121	2.23	20,235	Nov. 9	Jan. 23	75	Do.
27.....	1,500	10,540	17	85	2,200,000	1,100		1,375			135	1.90	12,150	Oct. 1	Nov. 20	50	Do.
28.....	2,300	12,719	16	85	3,066,000	1,533		1,000			150	1.90	16,000	Sept. 22	Nov. 7	56	Do.
29.....	6,557	67,251	15.2	81.2	14,698,000	7,349		37,219			143	2.22	40,626	Aug. 13	Dec. 24	128	Good.
30.....	3,465	35,897	14.2	80	6,998,000	3,499		22,966			131	2.21	31,963	Sept. 3	Dec. 19	108	Do.
31.....	5,710	24,013	11	76.7	4,902,000	2,451		23,074			338	2.17	30,809	July 25	Sept. 6	42	Poor.
32.....	5,183	28,112	17.5	80.9	6,166,000	3,083		7,400			173	1.52	22,569	Aug. 15	Nov. 10	86	Good.
33.....	6,000	56,000	17.2	82.5	12,000,000	6,000		36,379			175	2.11	44,974	July 20	Nov. 20	122	Good.
34.....	11,399	163,860	16.9	81.8	11,783,800	20,891.9		190,271			750	2.22	201,171	July 11	Nov. 10	121	Do.
35.....	19,665	271,321	16.5	82.6	57,400,000	28,700		359,600			800	2.20	214,720	Sept. 5	Jan. 8	122	Fair.
36 <sup>b</sup>																	
37.....																	
38 <sup>b</sup>																	
Total and av'ge	175,083	1,685,688.6	14.8	82.2	369,211,733	184,605.9		210,229	669,509	4,000	8,762	2.16	1,666,602			88.2	

<sup>a</sup> Beets shipped to factory No. 20.

<sup>b</sup> Beets shipped to factory No. 37.

## Results of factory operations in the United States, campaign of 1901.

Factory number.	Area of beets harvested.	Aver- age yield per acre.	Beets worked.		Coal used.		Fuel oil used.		Limestone used.		Ratio of materi- als to beets, <sup>a</sup>			Cost of working beets per ton for—			Sugar produced.	
			Tons.	Cost.	Tons.	Cost.	Bar- rels.	Cost.	Tons.	Cost.	P. c.	Fuel oil.	Lime stone.	Labor.	Fuel oil.	Lime- stone.	Per acre.	Per ton.
1	3,200	7.9	25,200	\$113,400	3,707	\$11,121			1,505	\$3,010	P. c.			\$0,762	\$0,441	\$0,119	1,563	198
2	2,793	7.7	21,400	96,300	4,226	12,678			1,389	2,778	14.7			1,728	.592	.130	1,553	203
3	1,800	6.8	12,300	53,350	3,300	9,900			1,035	2,070	19.7			1,626	.805	.168	1,384	203
4	7,100	9.2	65,000	292,500	13,000	39,000			5,200	10,400	26.8			1,954	.600	.160	2,000	218
5	4,600	8.7	40,000	180,000	10,000	30,000			2,800	5,600	20			1,969	.750	.140	1,783	200
6	7,000	8.7	61,000	274,500	10,350	31,050			3,462	6,924	17			1,992	.509	.114	1,964	225
7	820	12	9,841.8	44,287	1,600	4,800			690	1,380	16.3			1,866	.483	.140	2,160	180
8	6,000	8.8	53,000	238,500	10,000	30,000			9,700	19,400	18.3			1,115	.566	.366	1,943	225
9	3,000	9.6	28,789	129,550	4,100	12,300			2,000	4,000	14.2			1,139	.427	.139	1,933	200
10	4,000	7.9	31,600	142,200	6,300	18,900			2,200	4,400	19.9			1,018	.598	.139	1,656	210
11	6,000	7.3	43,500	195,750	7,300	27,000			2,744	5,488	20.7			1,057	.621	.126	1,350	180
12	3,619	7.2	26,134.5	117,603	7,300	22,500			2,575	5,150	28.7			2,062	.861	.197	1,371	190
13	3,110	9	28,000	126,000	5,600	16,800			2,850	5,700	20			1,446	.600	.204	2,251	250
14	5,200	8.7	45,000	202,500	9,500	28,500			3,000	6,000	21.1			1,111	.633	.133	1,731	206
15	3,300	6.7	22,000	99,000	4,500	13,500			2,250	4,500	20.5			1,963	.614	.205	1,333	201
16	6,000	9	54,000	243,000	10,800	32,400			5,500	11,000	20			2,948	.600	.204	1,800	200
17	2,470	7.4	18,245	82,102	3,101	9,303			1,277	2,554	17			2,084	.510	.140	1,403	190
18	3,200	8.8	28,000	126,000	5,950	17,850			3,000	6,000	21.3			1,286	.638	.214	1,688	193
19	3,200	10	28,000	144,564	8,000	24,000			4,000	8,000	29			1,116	.747	.249	1,888	211
20	4,717	8.1	37,985	170,332	7,066	21,018			4,878	9,756	18.4			1,003	.553	.257	1,677	208
21	1,000	11.5	4,000	18,000	800	2,400			423	850	20			1,660	.600	.213	1,040	268
22	5,600	11.5	64,650	290,925	16,162	48,486			3,880	7,760	25			1,219	.730	.120	2,540	220
23	9,969	9.4	93,559	421,015	19,950	59,850			8,610	17,220	21.3			1,219	.640	.184	2,432	250
24	3,100	9.8	30,420	136,890	6,000	18,000			2,200	4,400	19.7			1,991	.592	.145	2,548	263
25	7,000	12.2	78,500	353,250	11,000	33,000			4,500	9,000	14			5,575	.420	.115	2,421	239
26	3,206	11.9	41,461	186,575	6,100	18,300			2,144	4,288	14.7			1,676	.441	.103	2,495	197
27	2,300	10.1	23,305	104,873	3,902	11,706			1,238	2,476	16.7			1,868	.502	.106	1,896	180
28	1,500	7	10,500	47,250	1,375	4,125			850	1,700	13.1			1,157	.393	.162	1,467	214
29	2,300	5	12,719	57,236					780	1,560				1,258		.123	1,333	240
30	6,557	10.3	67,251	302,630					7,613	15,226	55.3			1,604		.226	2,242	219
31	3,465	10.4	35,897	161,337					3,042	6,084	64			1,890		.224	1,692	195
32	5,183	4.2	24,013	108,059					1,815	3,630	13.9			1,283		.336	1,817	858
33	5,183	4.8	25,112	113,004	7,400	22,200			3,895	7,790	29.5			1,899	.884	.151	1,190	246
34	6,000	9.3	56,000	252,000					3,032	6,064	65			1,803	.227	.108	2,000	214
35	11,399	14.4	163,860	737,370					40,048	80,096	116.1			1,231	.406	.245	3,666	255
36	19,665	13.8	271,321	1,220,945					359,600	719,200	132.5			1,791	.464	.274	2,919	212
37									37,200	74,400								
Total and average.....	175,083	9.6	1,685,688.67	585,599.210	229,630.687	630,327.163	322,325.644	669,509.234	327,163	322,325.644	19.9	108.3		.989	.379	.194	2,109	219

<sup>a</sup> The percentage figures in these columns simply express the ratio between the number of tons of beets on the one hand and the number of tons, barrels, or cords on the other.

MISCELLANEOUS SUGAR STATISTICS.

Through the courtesy of Mr. Frank H. Hitchcock, chief of the Section of Foreign Markets, Department of Agriculture, the following tables were compiled in order to bring out certain information especially interesting at the present time. The figures given are based partly upon official returns and partly upon statistics published by leading commercial authorities.

These tables contain a fund of information of great value to all persons who are making a study of the sugar question, whether from a practical or an economic standpoint.

*Average import price per pound of sugar imported into the United States. <sup>a</sup>*

Years ended June 30—	Sugar not above No. 16, Dutch standard.						Sugar above No. 16, Dutch standard.
	Beet.	Cane and other.				Average for all not above No. 16.	
		From Hawaii.	From Porto Rico.	From Cuba.	From other countries.		
	<i>Cents.</i>	<i>Cents.</i>	<i>Cents.</i>	<i>Cents.</i>	<i>Cents.</i>	<i>Cents.</i>	<i>Cents.</i>
1891.....	2.8	4.2	3.0	3.1	2.7	3.0	3.8
1892.....	2.8	2.8	2.9	3.1	2.7	2.9	3.8
1893.....	2.9	2.9	3.2	3.3	2.8	3.1	3.9
1894.....	3.1	2.9	3.2	3.0	2.7	2.9	3.8
1895.....	2.0	2.7	1.8	2.2	1.9	2.1	2.8
1896.....	2.3	3.2	2.1	2.2	2.1	2.3	2.9
1897.....	1.8	3.1	1.8	2.1	1.9	2.0	2.5
1898.....	1.9	3.3	1.9	2.2	1.9	2.2	2.4
1899.....	2.1	3.7	2.3	2.5	2.1	2.4	2.7
1900.....	2.1	4.0	3.4	2.6	2.2	2.5	3.4
1901.....	2.2	3.9	3.4	2.4	2.2	2.5	2.7

<sup>a</sup> Based on official returns published by the Bureau of Statistics, Treasury Department. These figures represent the wholesale market prices at the ports of shipment, and do not include the import duty levied in this country, nor the cost of transportation to this country.

*Average market price of sugar per pound in New York City. <sup>a</sup>*

Calendar years.	89° muscovado.	96° centrifugal.	Granulated.
	Cents.	Cents.	Cents.
1891.....	3.4	3.9	4.6
1892.....	2.8	3.3	4.3
1893.....	3.2	3.7	4.8
1894.....	2.6	3.2	4.1
1895.....	2.9	3.3	4.2
1896.....	3.2	3.6	4.5
1897.....	3.1	3.6	4.5
1898.....	3.7	4.2	5.0
1899.....	3.9	4.4	4.9
1900.....	4.0	4.6	5.3
1901.....	3.5	4.0	5.0

<sup>a</sup> According to statistics published by Willett & Gray, of New York City.

*Weekly receipts and market value <sup>a</sup> of imported sugar at United States ports <sup>b</sup> in 1901.*

Weeks ended—		Receipts.	Price per pound of 96° centrifugal.	Value.
1901.		Tons.	Cents.	Dollars.
Jan.	3.....	7,068	4½	692,664
	10.....	43,962	4½	4,308,276
	17.....	29,910	4½	2,931,180
	24.....	28,112	4½	2,676,262
	31.....	43,287	4½	4,120,922

<sup>a</sup> Based on receipt and price statistics published by Willett & Gray of New York City.

<sup>b</sup> New York, Boston, Philadelphia, and Baltimore.



*Weekly receipts and market value of imported sugar, etc.—Continued.*

Weeks ended—		Receipts.	Price per pound of 96° centrifugal.	Value.
1901.		Tons.	Cents.	Dollars.
Feb.	7	58,062	4½	5,527,502
	14	30,857	4½	2,937,586
	21	28,209	4½	2,665,751
	28	42,868	4½	4,021,018
Mar.	7	51,609	4½	4,696,419
	14	45,149	4	4,045,350
	21	36,707	4½	3,314,642
	28	39,347	4½	3,553,034
Apr.	4	22,237	4½	2,023,567
	11	52,047	4½	4,772,710
	18	6,203	4½	581,841
	25	49,547	4½	4,647,509
May	2	39,510	4½	3,761,352
	9	56,729	4½	5,440,311
	16	33,083	4½	3,167,865
	23	38,167	4½	3,660,215
	31	40,655	4½	3,870,356
June	6	38,212	4½	3,637,782
	13	64,628	4½	6,152,586
	20	44,678	4½	4,253,346
	27	39,592	4½	3,741,444
July	3	58,884	4½	5,564,588
	11	36,368	4½	3,411,318
	18	34,769	4½	3,236,994
	25	18,647	4½	1,749,089
Aug.	1	22,165	4½	2,063,562
	8	14,624	4½	1,351,258
	15	23,255	4	2,083,648
	22	29,658	4	2,657,357
	29	46,168	3½	3,942,747
Sept.	5	17,484	3½	1,468,656
	12	39,778	3½	3,341,352
	20	37,374	3½	3,139,416
	26	12,522	3½	1,051,848
Oct.	3	18,066	3½	1,517,544
	10	34,168	3½	2,870,112
	17	16,174	3½	1,353,616
	24	53,406	3½	4,560,872
	31	35,009	3½	2,989,769
Nov.	7	26,122	3½	2,194,248
	14	26,463	3½	2,204,368
	21	19,275	3½	1,592,115
	29	13,421	3½	1,127,364
Dec.	5	11,089	3½	931,476
	12	25,430	3½	2,136,120
	19	35,432	3½	2,976,288
	26	12,409	3½	1,016,297
	31	24,460	3½	1,986,152
Totals and average		1,753,005	<sup>b</sup> 4.07	159,724,614

<sup>a</sup> Quotation of January 2, 1902.

<sup>b</sup> This price is a properly weighted annual average based on the total receipts for the year and their value, as obtained by applying the weekly price quotations to the weekly receipts.

#### PRODUCTION AND CONSUMPTION OF SUGAR IN THE UNITED STATES GRAPHICALLY PRESENTED.

The present development of the sugar industries of the United States can be illustrated in no better way than by mapping the States and groups of States which produce as much or nearly as much sugar as they consume. Uniting these groups shows the area that our present production of sugar is sufficient to supply. There are three States in which the beet-sugar industry has already developed to the extent of supplying the demands for consumption within their own borders and partially supplying the demand from adjoining States.

The numbers employed in the following tables and maps have been derived as follows:

The population is taken from the reports of the Twelfth Census.

The figures for consumption of sugar are found by multiplying the population by the average consumption of sugar in pounds per capita for the whole country according to the most reliable statistics.

The figures for production of sugar have been made up from actual returns made by manufacturers and estimates made by reliable authorities.

For the purpose of graphic presentation, the States and Territories west of the Missouri and Mississippi rivers are divided into the following groups:

Group I. Washington, Oregon, and California.

Group II. Idaho, Nevada, Utah, and Arizona.

Group III. Montana, Wyoming, Colorado, and New Mexico.

Group IV. Nebraska, Kansas, Oklahoma, Indian Territory, Texas, Arkansas, and Louisiana.

In these tables, after the first one, the totals are carried forward so as to show the comparison of production and consumption of sugar, not only by States and groups, but by combinations of groups.

GROUP I.

*Population, and consumption and production of sugar for 1901.*

State.	Population in 1900.	Consumption of sugar.	Production of beet sugar.
California .....	1,485,053	<i>Pounds.</i> 101,577,800	<i>Pounds.</i> 143,947,800
Washington .....	518,103	35,438,245	2,200,000
Oregon .....	413,536	28,285,862	3,066,000
Total .....	2,416,692	165,301,907	149,213,800

The accompanying map (fig. 1) shows the population, consumption of sugar, and the production of beet sugar in Washington, Oregon, and California, the Pacific States, constituting Group I. Ten years ago but little sugar was produced in this area, and that in but one State, California. Now the production nearly equals the consumption, while that of California alone exceeds her consumption by over 42,000,000 pounds. Factories are in operation in each of these States, and others are projected which should largely increase production in the near future. The development of the industry in this section during the past few years may be taken as an indication of the development which may be looked for in other areas during the next decade.

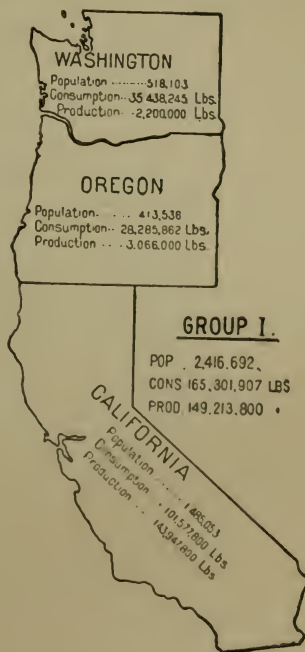


FIG. 1.—Population, and consumption and production of sugar in the Pacific coast States.

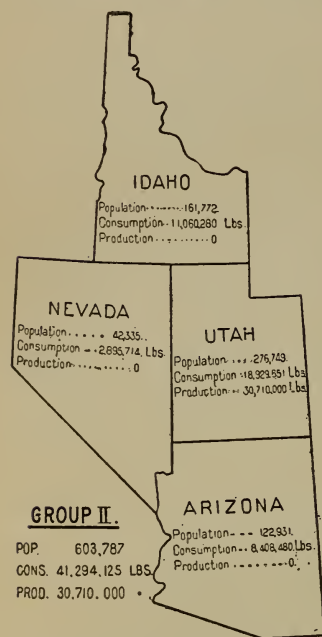
## GROUP II.

*Population, and consumption and production of sugar for 1901.*

State or Territory.	Population in 1900.	Consumption of sugar.	Production of beet sugar.
		<i>Pounds.</i>	<i>Pounds.</i>
Idaho .....	161,772	11,060,280	.....
Nevada .....	42,335	2,895,714	.....
Utah .....	276,749	18,929,651	30,710,000
Arizona .....	122,931	8,408,480	.....
Total, Group II.....	603,787	41,294,125	30,710,000
Group I.....	2,416,692	165,301,907	149,213,800
Total, Groups I and II.....	3,020,479	206,596,032	179,923,800

Group II (fig. 2) includes the States of Idaho, Nevada, and Utah, lying almost wholly in what is called the Great Basin, and the Territory of Arizona. Ten years ago there was but one small factory in this area, that at Lehi, Utah. Now there are three sugar factories (one of which has three separate rasping stations), and the product of sugar is nearly three-fourths the amount consumed. A present this production is confined to one State, Utah, in which the production exceeds the consumption by about 12,000,000 pounds. The Utah Sugar Company has increased its capital, and contracted for beets with a view to erecting, in the Bear River Valley, another large factory. A company has been organized and capitalized, and contracts have been made for growing beets with a view to the building of a 1,000-ton factory at Phoenix, Ariz. Projects for the construction of factories in Nevada and Idaho are receiving consideration. On the whole, it is safe to say that this group will soon produce more sugar than the amount consumed.

FIG. 2.—Population, and consumption and production of sugar in the Great Basin States and Arizona.



The united totals for Groups I and II show that the production of the combined groups is more than six-sevenths of the amount consumed.

## GROUP III.

*Population, and consumption and production of sugar for 1901.*

State or Territory.	Population in 1900.	Consumption of sugar.	Production of beet sugar.
		<i>Pounds.</i>	<i>Pounds.</i>
Montana .....	243,329	16,643,703	.....
Wyoming.....	92,631	6,329,120	.....
Colorado.....	539,700	36,915,480	47,411,600
New Mexico.....	195,870	13,397,508	.....
Total, Group III.....	1,071,430	73,285,811	47,411,600
Groups I and II.....	3,020,479	206,596,032	179,923,800
Total, Groups I-III.....	4,091,909	279,881,843	227,335,400



In Group III (fig. 3) are included the Rocky Mountain States, Montana, Wyoming, and Colorado, and the Territory of New Mexico. Three years ago every pound of sugar consumed in Colorado was brought in from the outside. Now her production equals her consumption and leaves a surplus sufficient to supply Wyoming, with over 4,000,000 pounds to spare, equal to one-third of New Mexico's consumption. In the group, the production is about two-thirds of the consumption. The production last year was confined to Colorado, in which there are three factories in successful operation, with three more building or preparing to build for the campaign of 1902 with a capacity for producing 37,000,000 pounds of sugar. These alone will make the production of this area considerably in excess of the amount consumed.

There is a factory with a daily capacity of 200 tons of beets at Carlsbad, N. Mex., but this was idle during 1901. There are several projects on foot for building factories in Montana and Wyoming. The total production of beet sugar in Groups I, II, and III was thirteen-sixteenths of the amount of sugar consumed.

GROUP IV.

*Population, and consumption and production of sugar for 1901.*

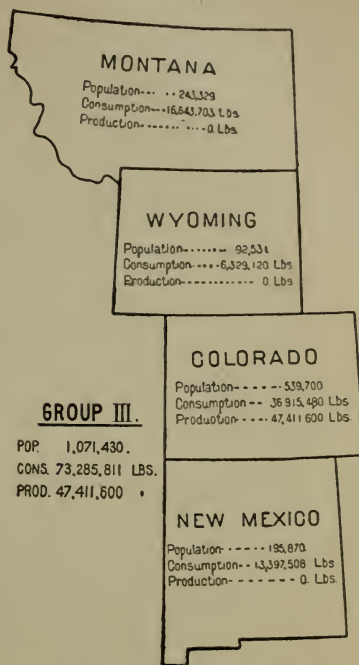


FIG. 3.—Population, and consumption and production of sugar in the Rocky Mountain region.

State or Territory.	Population in 1900.	Consumption of sugar.	Production of sugar.
		<i>Pounds.</i>	<i>Pounds.</i>
Nebraska.....	1,066,300	72,934,920	<sup>a</sup> 14,912,300
Kansas.....	1,470,495	100,580,858	.....
Oklahoma.....	398,331	27,245,840	.....
Indian Territory.....	392,060	26,816,904	.....
Texas.....	3,048,710	208,521,764	<sup>b</sup> 6,476,400
Louisiana <sup>c</sup> .....	1,381,625	94,503,150	<sup>b</sup> 616,000,000
Arkansas.....	1,311,564	89,710,977	.....
Total, Group IV.....	9,069,085	620,314,413	637,388,700
Groups I-III.....	4,091,909	279,881,843	<sup>a</sup> 227,335,400
Total, Groups I-IV.....	13,160,994	900,196,256	864,724,100
Total beet sugar.....	.....	.....	242,247,700
Total cane sugar.....	.....	.....	622,476,400

<sup>a</sup> Beet sugar.

<sup>b</sup> Cane sugar.

<sup>c</sup> Louisiana's output of cane sugar estimated by A. Bouchereau.

The only beet-sugar producing State in this group (fig. 4) is Nebraska, which has three factories, but produces only about one-fifth of the amount of sugar consumed in the State. Her product added to that of the groups already given raises the aggregate of beet-sugar produced in the four groups to 242,000,000 pounds.



FIG. 4.—Population, and consumption and production of sugar in a group of States lying in the Mississippi Valley and Gulf region.

In the State of Texas a small quantity of cane sugar is produced. Louisiana's product alone is almost equal to the entire sugar consumption of this group.

The accompanying map (fig. 5) shows the area of Groups I-IV in which the total production of sugar exceeds 96 per cent of the amount consumed.

#### SUGAR PRODUCT OF THE WHOLE COUNTRY.

##### *Beet sugar produced in 1901 outside of Groups I to IV.*

	Pounds.
Minnesota .....	5,400,000
Wisconsin .....	3,466,550
Michigan .....	106,267,500
Ohio .....	2,492,000
New York .....	9,337,983
Total .....	126,964,033

It will be observed that the great bulk of the sugar produced east of the Mississippi is made in Michigan, where 13 factories were in successful operation in 1901.

##### *Sugar produced in the United States in 1901.*

	Pounds.
Beet sugar, Groups I to IV .....	242,247,700
Beet sugar, other States .....	126,964,033
Beet sugar, United States .....	369,211,733
Cane sugar, United States .....	622,476,400
Total sugar, United States .....	991,688,133

If to the beet-sugar product of the four groups mapped, the sugar produced in the other States be added, we have a total of 369,211,733 pounds of beet sugar produced in the United States in 1901. The cane-sugar product of the country (622,476,400 pounds) added to this

gives a grand total of 991,688,133 pounds of sugar produced in the United States last year. This total product is sufficient to cover the consumption of the four groups of States given, together with that of North and South Dakota (50,296,816 pounds), and leave 41,000,000 pounds to apply elsewhere. Therefore, if we add to the area mapped

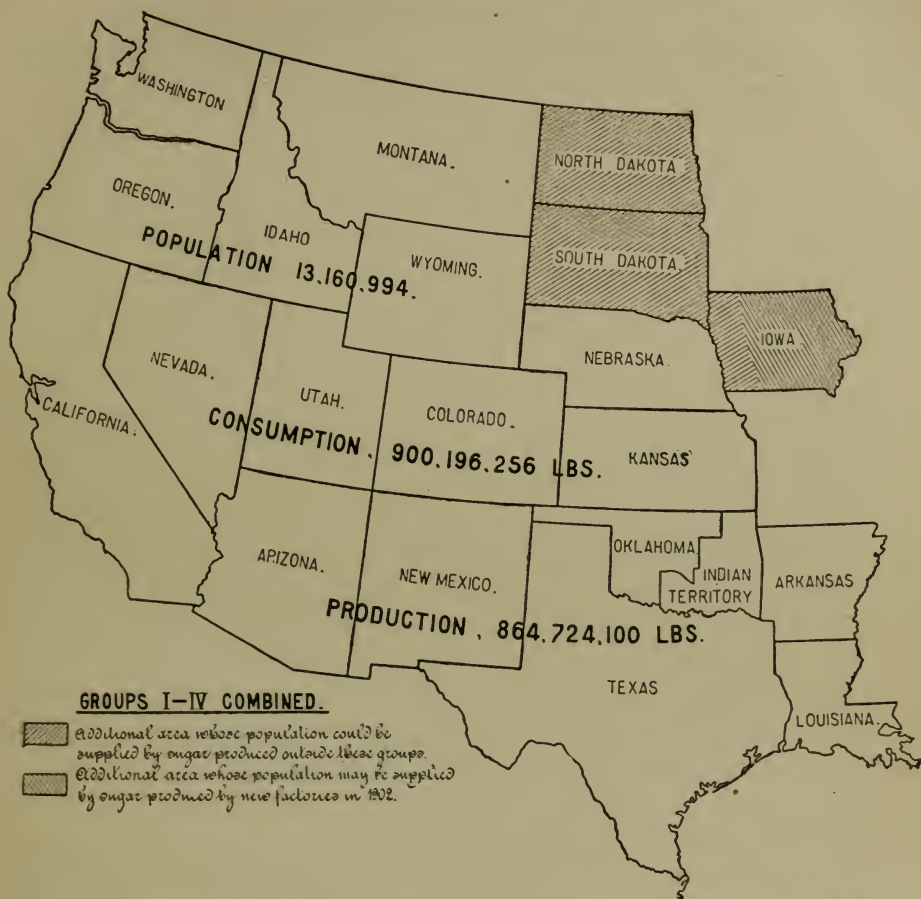


FIG. 5.—Population and consumption and production of sugar in the territory lying west of the Mississippi and Missouri rivers.

(fig. 5) that of North and South Dakota and about one-fourth of Iowa, we have the territory whose population could have been supplied with the home product of sugar in 1901.

#### PROSPECT FOR 1902.

New factories will probably be built and prepared to make beet sugar in 1902, whose estimated production is shown, by States, in the following table:

#### *Estimated production of new factories for 1902.*

	Pounds.
Arizona .....	20, 000, 000
Colorado .....	36, 000, 000
Michigan .....	48, 000, 000
Wisconsin .....	10, 000, 000
Total .....	114, 000, 000



The consumption of sugar in Iowa is 156,000,000 pounds. If, then, the product of the factories making sugar in 1901 increases equally with increase in consumption in 1902, the additional product made by these new factories will add to the area of consumption supplied by the home product the equivalent of three-fourths of Iowa's territory.

From these figures it will be seen that the time is rapidly approaching when the United States will produce as much sugar as is consumed in the entire area west of the Mississippi River.

#### PROBABLE FUTURE OF THE INDUSTRY.

The consumption of sugar in the United States during 1902, calculated from the figures for 1901, will be approximately 2,500,000 tons, and the production (both cane and beet) will reach nearly 500,000 tons. This leaves 2,000,000 tons to be brought in from outside the United States proper. Of this amount Porto Rico should supply 100,000 tons and Hawaii 300,000, a total of 400,000. Deducting this amount from 2,000,000 tons leaves 1,600,000 to be brought from foreign sources paying duty. While the above are only estimates in round numbers, they are believed to be substantially correct.

It is the ambition of those encouraging the sugar industry to establish factories enough at least to supplant this foreign supply. Making due allowance for failure of factories to reach in actual production their full capacity under ideal conditions, it would require 500 factories having a daily capacity of 500 tons of beets to produce this sugar. There will doubtless be an increase in the production of cane sugar in the South which should be taken into account. But for convenience of calculation it is here assumed that the increase will be in beet-sugar production only. To equip and build these factories will require an investment of capital of \$250,000,000. This vast sum of money must be expended in this country for building materials and machinery, and in the employment of the labor necessary to construct and equip the factories. The annual result of these factories will be as follows:

#### *Annual requirements and expenditures of 500 beet-sugar factories.*

Beets .....	tons..	18, 750, 000
Amount paid to farmers for the beets .....		\$84, 375, 000
Coal .....	tons..	3, 187, 500
Amount paid to coal dealers .....		\$9, 562, 500
Limestone .....	tons..	1, 875, 000
Amount paid for limestone .....		\$3, 750, 000
Coke .....	tons..	375, 000
Amount paid for coke .....		\$3, 000, 000
Amount paid for labor in the factories .....		\$19, 000, 000

In addition to the above, large amounts of money will be paid for mill supplies, transportation, etc. As a working capital to operate these factories, about \$135,000,000 will be required for the campaign

of four months. This is equivalent to the employment of \$45,000,000 for one year. We should remember that the above estimates do not include the capital already invested in the business, the statement of which is as follows:

*Present development of the beet-sugar industry.*

Capital invested in factories, equipment, and grounds .....	\$30,000,000
Amount of beets purchased annually.....tons..	1,875,000
Cash paid for beets purchased annually.....	\$8,437,500
Coal consumed annually .....	318,750
Cash paid for coal annually .....	\$956,250
Limestone purchased annually .....	187,500
Cash paid for limestone annually .....	\$375,000
Coke purchased annually. ....	37,500
Cash paid for coke annually.....	\$300,000
Cash paid for labor annually .....	\$1,900,000
Operating capital employed annually .....	\$5,000,000

Also, there is a considerable amount annually expended for various other things, such as crude material, etc. It hardly seems possible that an industry which affects so many people over such a wide scope of country can fail to receive anything but the most friendly, careful, and fostering consideration on the part of those who shape industrial affairs.

The immensity of future demands, it seems, answers pretty effectually those who feel that the industry might be overdone. Attention should be called to the fact that not only are present demands great, but the rate of increase of consumption is considerable.

Five years ago the State of Michigan was making the preliminary inquiries into beet growing and sugar production, and all the sugar consumed was brought into the State. Four years ago 1 factory was constructed, the following year 9, and the next year 3. (See Pl. II.) Four are now in the course of construction for the campaign of 1902. In 1901 the production of the State was very nearly three-fourths the entire amount of sugar consumed. These results were accomplished in four years.

The States of New York, Ohio, Illinois, Wisconsin, Iowa, and Minnesota compare very closely in natural conditions and resources to the State of Michigan. Some of them have natural advantages that Michigan has not. In these States the sugar industry has not been taken up and developed as rapidly as in Michigan, but eventually some if not all of them will be equally important factors in the production of beet sugar. There are several other States that can produce beets of sufficient quantity, quality, and purity. Among them are Pennsylvania, North and South Dakota, and Nebraska, the latter having already made a good start. All the States, beginning with New York in the East and ending with Nebraska in the West, grow sugar beets with moisture supplied by rainfall, and the conditions and methods of agriculture are very much alike throughout.

For the future development of the sugar industry we can look confidently to Colorado, Wyoming, Montana, Idaho, Utah, Arizona, and Nevada. Beet growing under irrigation is peculiarly successful, and may, with its aid, be extended south into Kansas and other States in this latitude. In no other area in the United States is the prospect for future growth of the industry better than in the mountain States. Sugar production in this area means what wheat does to Kansas and Minnesota, what corn does to Iowa and Illinois, what cotton does to Mississippi, Alabama, and other States of the South, and what fruit culture means to California. The arid region will assume agricultural prominence largely through the influence of beet-sugar production as surely as have these through the various products mentioned. Whatever else can be said of the sugar beet, it is a blessing to the arid region.

The States of the Pacific slope produce their agricultural products both by rain and irrigation. These States are destined to assume prominent positions in sugar producing.

The tables given show that sugar production in our country, unlike most other industries, has found its first and greatest success in the West, and from there has progressed eastward. It is preeminently an agricultural interest. In the agricultural group it is destined not only to stand by virtue of its own merits and strength, but to lend liberally of its own resources to the rest of the group, reenforcing their importance. It brings the factory and farm side by side. It brings farmers, laborers, and capitalists into close association and cooperation. It places supply at the door of demand. It meets the logic of modern times in the concentration of advantages and the conservation of forces. It eliminates the foreign grower as a factor in the supply of our daily wants, our business methods, and the emergencies of war.

The development of the beet-sugar industry tends to prevent the concentration of manufacturing interests in some sections of the country, and of agricultural interests in others. It conforms to an ideal system, and simplifies the problems of our social and economic life. It is a great decentralizing power. It can not be compressed into any small area. The factory must go to the place where the beets are grown. It does not pay to ship this raw material any considerable distance. The result is that the beet-sugar factory must be the center of a certain area, and there must be many of these centers distributed generally over the country.

#### REVIEW OF FACTORY OPERATIONS FOR 1901.

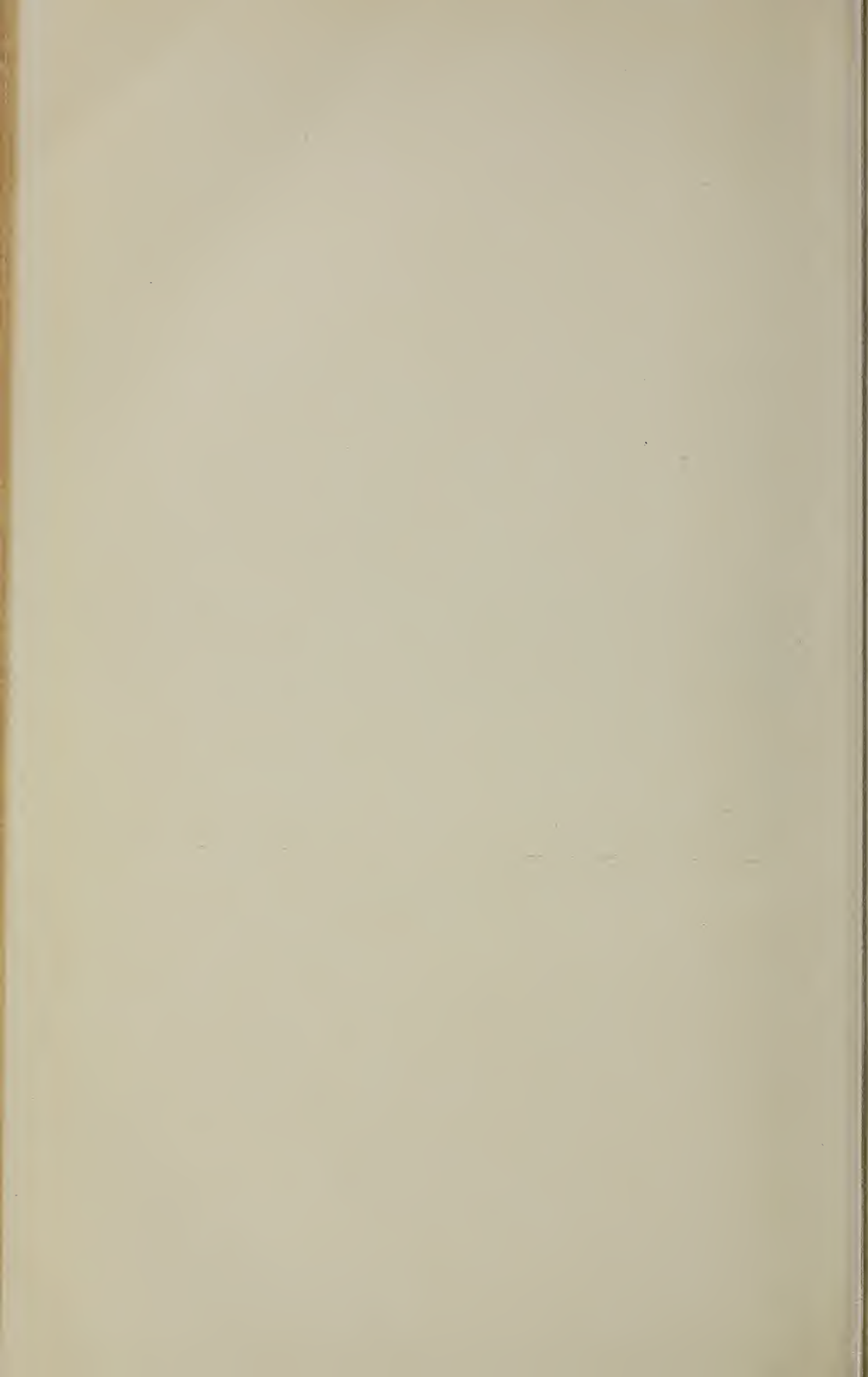
##### GENERAL OBSERVATIONS.

Taking the United States as a whole the crop conditions, so far as sugar beets are concerned, were quite favorable. Better results were obtained through the whole country during the past year than during





A REPRESENTATIVE MICHIGAN FACTORY, CARO, MICH.



any previous year. These favorable results can be partially attributed to the effect of experience, both in the factory and on the farm. Both the farmer and the manufacturer are learning how to combat or avert unfavorable conditions. The farmer is learning how to cope with pests, how to render a drought least injurious to his crops, how and when to plant and irrigate. The germinating period of the sugar-beet plant's life is the time of greatest danger. Excessive rain or irrigation is detrimental, and a dry condition of the soil, resulting from insufficient irrigation or rainfall is harmful. The baking of the soil, either by rainfall or irrigation, is fraught with serious consequences when the young plants strive to push through the surface. Methods for overcoming this condition are better understood than heretofore. The beet plant thrives on so many different kinds of soil that the farmer must know the methods to apply to the different ones. As the sugar-beet growing area extends, experience and information are acquired.

Year before last beet diseases were prevalent throughout the country. This was unfortunate in its effects on the crop of that year, but it was beneficial in adding to the fund of experience in sugar production. The season before that offered obstacles to the farmer in the form of insect pests, which were quite prevalent. For three seasons previous to 1901 there were unprecedented droughts. On the Pacific coast sugar beets yielded from one-fourth to three-fourths of a crop, southern California suffering the most in this respect. Throughout this time the drought affected the whole country to quite an extent. Disease, insect pests, and drought are the main obstacles to be met in the cultivation of beets. Throughout the sugar-beet growing countries of Europe each of these obstacles has been encountered. It has been found that droughts frequently offer favorable conditions for the prevalence of one or both of the other enemies. By long experience European growers have learned how to deal with these difficulties, and to eliminate them to a great extent, and the season usually closes with favorable results in sugar-beet growing. This country is now going through the same process.

That defeat can be turned into victory finds no better illustration than in the experience with droughts on the Pacific coast. There sugar-beet growers proceed on the principle that the rainfall in the winter and early spring will be sufficient to produce a crop of beets. The soil there has the peculiar quality of conserving sufficient moisture to develop the crop. It is believed that natural subirrigation of the soil takes place in the underground drainage of moisture from the mountains to the sea; that the accumulations of water and snow in the mountains are gradually let down by seepage during the summer, and by capillary attraction brought to the surface in sufficient quantity to supply the growing crop during the season. This is undoubtedly true for the normal year. When the rain and snow in the mountains



fall short in the winter drought follows. The soil is not sufficiently saturated by direct rainfall in the winter, nor is the natural subirrigation sufficient during the growing season. Under such conditions poor crops are obtained. This is the explanation of the three-year drought referred to, and the experience taught the sugar-beet growers a lesson. Necessity is the mother of invention. They discovered that irrigation must be introduced to supplement rainfall. Advantage is now being taken of many natural facilities for irrigating lands, and there is constantly more land coming into use in growing sugar beets by irrigation. In many parts of California it is found that deep wells can be sunk, affording a bountiful supply of artesian water, and many of these are flowing wells. This means of securing water supply is in vogue around the Los Alamitos and Chino factories, in the vicinity of Pasadena and Los Angeles, and in many other sections of southern California. Experience with droughts started these people to seeking water, and the success of some induced others to try the experiment, so that, in the end, these droughts must be regarded as a most favorable circumstance. Most of the projects for sugar-beet factories now contemplated in coast sections have in view sugar-beet growing by irrigation.

In reviewing the operations of the various factories during the past campaign, I have begun with the Pacific coast States and moved eastward.

#### CALIFORNIA.

The results in California during the year 1901 were good. Most of the factories report favorably in regard to the sugar-beet crop. The sugar beets grown in California are always so high in quality and purity that their yield of sugar goes a long way toward making up for the low tonnage of beets in an unfavorable year. But the past year the tonnage has also been good.

An idea can be formed of California's importance in the sugar industry by noting the fact that she is able to provide sugar enough to supply about seven-eighths of the consumption of all the Pacific coast States, which is about 165,000,000 pounds. In this State there are many projects under consideration for further extending this important industry within its borders. It is quite probable that in the near future she will be doubling her present output.

This State has now eight factories, which will be discussed in regular order under the names of the towns in which the factories are located.

ALVARADO.—The Alameda Sugar Company is operating a factory at this place with a daily capacity of 700 tons of beets. This capacity would enable the factory to work 70,000 tons of beets annually and produce under average conditions 7,000 tons of sugar. It began operations August 19 and closed December 24, working a campaign of one hundred and twenty-eight days. The crop conditions were

favorable throughout its farming district. The factory had what is probably its most successful campaign, having secured beets sufficient and manufactured sugar therefrom almost to its nominal capacity.

**BETTERAVIA.**—The Union Sugar Company is operating a factory at this place of 500 tons daily capacity. It began its campaign September 3 and closed December 19, being in operation one hundred and seven days. The crop conditions for the year were favorable. Its capacity would enable this factory to work about 50,000 tons of beets, producing therefrom about 5,000 tons of sugar. Though the results of its campaign are looked upon as quite favorable, the factory did not nearly reach the limit of its capacity.

**CHINO.**—The American Beet-Sugar Company is operating a factory at this place of 1,000 tons daily capacity, which under ideal conditions should work up 100,000 tons of beets, producing therefrom about 10,000 tons of sugar. It began its campaign July 25, closing September 6, being forty-two days in operation. The company operating the Chino factory has another in operation at Oxnard having double its capacity. The Chino concern did not finish working its supply of beets, but, after a short campaign, sent the rest of the beets to Oxnard and they were worked up in that factory with its own supply. The crop conditions throughout the past year were below the average. I understand that through some defect or breakage in the machinery it was considered best to close down the Chino factory and finish the work at the Oxnard.

During the past year the factory concluded to facilitate the delivery of beets to the factory by placing at various points in its agricultural district, along the lines of railroads, beet dumps for loading cars by the farmers from wagons. This saves the farmer's time, making it possible for him to dispose of his crop quickly, and the beets are delivered to the factory in train loads.

**CROCKETT.**—The California Beet and Hawaiian Sugar and Refining Company is operating a beet-sugar factory here of 1,200 tons daily capacity. This concern combines the two functions of refining raw Hawaiian sugar and manufacturing refined granulated sugar from beets. It is unique in this respect. As a refiner it is able to operate the year round. It occurs to most persons unacquainted with the manufacture of beet sugar that it is expensive to put so much money in a beet-sugar plant and have it idle three-fourths of the year; and the question has frequently been asked: "Why not combine with the manufacture of beet sugar some other industry, by means of which the machinery can be used during the balance of the year?" The Crockett factory is working on this idea, and, if successful, it is to be presumed that other sugar factories will adopt some similar plan.

The crop conditions were quite unfavorable in this locality during the past year, with the result that the factory was not able to make a



showing of over one-third of what it could accomplish under more favorable circumstances. It began operations August 15 and closed November 10. When this factory shall work up to its capacity it will be an important factor in sugar production on the coast, as it will then use about 120,000 tons of beets annually, and produce therefrom about 12,000 tons of refined granulated sugar.

LOS ALAMITOS.—The Los Alamitos Sugar Company is operating a factory here with a capacity of 700 tons, which during an ordinary campaign would work about 70,000 tons of beets. It fell short of this about 14,000 tons during the past year. The crop conditions were much better in this district during the past year than in any other during its history. Through irrigation, by means of artesian wells, more certain and satisfactory crop conditions have been secured. The beets grown averaged in sugar content 17.5 per cent, which is a very high figure. The factory began operations July 20 and closed November 20. Some of the best beets grown for the factory were as high in sugar content as 25 per cent, with a coefficient of purity of 93 per cent.

The factory itself is ideal in design, and is destined to be a model sugar-producing enterprise. A comparison of the results of all the factories during the past year shows that only two other factories succeeded in working beets with a lower expense for labor per ton worked.

OXNARD.—The American Beet Sugar Company is operating a factory (Pl. III) at this place of 2,000 tons daily capacity. It began operations July 11 and closed November 10. It is the second largest factory in the United States. It had a good supply of beets, which averaged 16.9 per cent in sugar and 81.8 in coefficient of purity. It has taken advantage of the facilities for feeding pulp by putting in large feeding pens, and is feeding stock with that by-product. The crop conditions were favorable and the factory had one of its most encouraging years.

SALINAS.—The Spreckels Sugar Company is operating a factory here of 3,000 tons daily capacity. This is the largest beet-sugar producing enterprise in the United States, and one of the largest in the world. It began operation July 11 and closed November 10. Under ideal conditions, it should work about 300,000 tons of beets. The crop conditions were fairly good in the beet-growing districts surrounding this factory, but the supply did not reach this figure. It is not improbable, however, that in the near future under favorable conditions this factory will be able to reach the limit of its capacity. It requires time and effort to work the farming element up to the point of furnishing such a large supply. As the farmers realize the full benefits, direct and indirect, and learn to accomplish the work more cheaply and with less effort, what has hitherto been considered a task will become the natural ordinary enterprise of the valley.





FIG. 1.—BOILER HOUSE.



FIG. 2.—FILTER-PRESS STATION.

Interior views of factory at Oxnard, Cal.



WATSONVILLE.—The Spreckels Sugar Company has a factory here of 1,000 tons capacity. The season was fairly good and an average crop of beets was produced by the farmers in the vicinity. This factory is owned and operated by the same company as is the one at Salinas. In order to give that factory more nearly its capacity of beets, those raised for Watsonville were shipped to Salinas to be worked.

The Spreckels Company utilizes the sugar-beet pulp for feeding purposes. It has, during the past season, fed over 600 cows on this pulp with very satisfactory results. In this connection it may be stated that experiments have been made in some of the factories in expressing all the water out of the pulp, thus making its transportation at a low cost possible, a fact which will greatly aid in making of this by-product a regular article of commerce.

#### OREGON.

LAGRANDE.—The Oregon Sugar Company is operating a factory here of 350 tons. It began operation September 22 and closed November 7, having a campaign of 56 days. The crop conditions were only fair. This factory began operations originally by growing its beets in a valley near the factory, but, after an experience of two years, found that much better beets could be produced in another locality at some distance from the factory; as a result most of the beets are produced 10 to 20 miles distant, and are shipped in carload lots.

This case furnishes a striking illustration of the necessity of a careful soil survey of the neighboring region before undertaking the establishment in any locality, of a beet-sugar factory. At the same time, the fact that some railroads have made a rate for sugar beets of 50 cents per ton for 50 miles or less will be a great help where the beets have to be carried some distance.

The factory has had considerable difficulty in getting the farmers interested in the crop. With a good deal of effort it has been able to secure about one-half enough beets to meet its requirement for an ordinary campaign. The beet crop started last spring under very favorable circumstances, but a late frost came on June 4 and did much damage to most farm crops, and seriously injured the beet crop, cutting it down about one-half. The factory itself planted about 1,000 acres to beets, which were raised under its own supervision. It finally harvested about 600 acres, yielding 4,800 tons. I visited this section in October, and talked with some of the local farmers. They had done exceedingly well with beets, which was especially gratifying, since their other crops were poor. One of them had 80 acres of beets from which he secured about 16½ tons per acre, and for which he received \$4.50 per ton, or \$73.12 per acre, netting him over the cost of production about \$40 per acre. Farmers who deliver beets to the cars get \$4 per ton.



## WASHINGTON.

WAVERLY.—The Washington State Sugar Company is operating a factory here of 350 tons daily capacity. Like the factory in Oregon, this one has had to struggle along, contending with obstacles, but each year sees considerable improvement, and the future for the enterprise is very much clearer. The crop conditions were only fair in the State during the past year. The farmers did not produce nearly enough beets for the capacity of the factory.

The factory began operations October 1 and closed November 20. The price paid for beets was \$5.25 a ton, and it cost about \$31 an acre to raise them. The farmers are beginning to see the advisability of feeding pulp. In fact, all the obstacles are being gradually met. The average sugar content and purity were very high this year, being 17 and 85 respectively.

## UTAH.

The sugar industry has found specially favorable conditions in the State of Utah. There are conditions in Utah that do not obtain in any of the other States. The people of Utah were educated from the beginning to produce whatever they might need. This grew out of the peculiar history of the people who settled the country. About fifty years ago a commission was sent from the Territory to Europe to secure a beet-sugar factory. Considering the times, facilities for transportation, and the limited resources of those people, the effort was remarkable. This commission succeeded in securing a beet-sugar factory, and brought it back to this country. At that time they could bring it by rail only to the Missouri River. Strongly built wagons were specially constructed for conveying it the rest of the way over the mountains to Salt Lake City. Oxen were purchased, and a caravan started hauling this beet-sugar machinery. They were finally overcome by the snows and storms of winter in the Rocky Mountains. Most of the oxen died, and the people conducting the train made their way to Salt Lake City. In the spring a new outfit of men and oxen started out to recover the machinery and bring it to Salt Lake City, and this was finally accomplished. It appears that the energies of the people were exhausted by this tremendous effort, and the beet-sugar machinery was never installed or put to a practical test.

Agriculture in Utah progressed with the evolution of irrigation. Thirteen years ago a beet-sugar factory was established at Lehi. It had back of it the industry and energy of this class of people. It was bound to succeed. In the pioneer work of this factory it had many things to overcome. The agriculture of the district had absolutely nothing to guide it in the application of irrigation to sugar-beet culture. Whatever is known to-day on that subject has been mostly

derived from the experience of the factory at Lehi, Utah. At first the tonnage, sugar content, and purity of the beets were low. The obstacles have been gradually overcome, and to-day this factory produces sugar at the lowest cost of any in the United States. It has introduced a feature that is unique in sugar production in our country. When it started, this factory had a daily capacity of 350 tons of beets. It was found that the railroads were inadequate to furnish beets sufficient to keep the factory going if the capacity should be increased, inasmuch as at this time they were busy handling other products. The manager, Mr. Cutler, conceived the idea of establishing in different directions from the factory slicing stations. These slicing stations perform only a part of the work of a regular factory. They slice the beets and run the cossettes through the diffusion batteries, extracting the juice, which is limed and sent to the main factory at Lehi. In order to do this the main factory had to be increased in capacity sufficiently to extract the sugar from this juice.

There are three slicing stations, one each at Springville, Provo, and Bingham Canyon. Each has a capacity for slicing 350 tons of beets daily. Those at Springville and Provo work alternately, using the same set of hands. The central factory at Lehi has itself a capacity for slicing 350 tons of beets. This requires that the main factory at Lehi have a capacity for working the juice from 1,050 to 1,100 tons of beets daily. These slicing stations are from 12 to 20 miles from the main factory, and each station works the beets secured in its immediate vicinity. The factory is no longer dependent on any congested condition of railway traffic, since the juice is delivered through these pipe lines instead of by railroad. There is every indication that this system is a success, and the future may see it adopted in many other localities where the conditions require it. It is a system which can be used in almost any section of the country, if the main factory can be established at a point having desirable railroad facilities, cheap fuel, good water, and other suitable conditions. These pipe lines can be run out to other localities having facilities for growing good sugar beets, and these localities will enjoy all the advantages of a main factory, the farmer being able to deliver his beets with a short haul, and secure his pulp.

Utah not only possesses advantages in her well-established irrigation system, but also has many other natural facilities. While it does not possess enough rainfall to grow a crop of sugar beets, it does secure sufficient rainfall in the spring to germinate the seed and start the plants. After that the crop is produced by irrigation. At many points good pure water for factory use can be secured from streams fed by melting snows in the mountains. These streams also afford water power for running electric-power plants which can be utilized to great advantage in sugar factories.



In the irrigated sections it has been found that the resources of the soil can be very much enhanced by artificial fertilization. As these sections grow older the necessity for this will be more apparent. The following statements are given on the authority of Thomas R. Cutler, president of the Utah Sugar Company, of Lehi: It has been recently discovered that in Salt Lake there are two islands affording an abundance of guano. These islands are the rookeries of different species of birds. The first is called Hat Island, more or less round in outline, and having a diameter of about  $1\frac{1}{2}$  miles. This is the home of the pelicans of that region, where they go to breed and rear their young, depositing guano, which affords resources for fertilizing the lands. It is estimated that there are about 75,000 tons of guano on this island. These birds feed upon fish, and the guano is very rich in plant food. The other island is called Gunnison, and is the home of the gulls. Its dimensions are about  $3\frac{1}{2}$  by  $3\frac{1}{4}$  miles. It has been found that the animal life in the Great Salt Lake is very limited, but there is a species of small shrimp that is quite numerous, and on these the gulls feed. The action of the waves has thrown upon this island for centuries thousands of tons of these small animals, which leave a deposit rich in fertilizer. It is estimated there are on this island in the neighborhood of 285,000 tons of guano and shrimp fertilizer which is worth \$55 a ton.

LEHI.—The Utah Sugar Company is operating a factory here having a slicing capacity of 350 tons, and a capacity for working juice from 1,100 tons of beets daily, which includes the juice from its slicing stations. It began operations September 25 and closed December 16. Conditions for sugar-beet growing throughout its agricultural region were quite good during the past year. At Springville about 1,000 acres of beets were harvested. This district secured an average tonnage of 16, with an average sugar content of 16 per cent and a purity of 84, a very remarkable showing for a district having such a large acreage under cultivation. It takes about sixteen to twenty-four hours for the juice from these different stations to reach the main factory through the pipe lines. The fresh pulp from the factory is sold to the consumers at 40 cents per ton, allowing 2,500 pounds per ton, or 2,000 pounds if the pulp is pressed or allowed to stand any considerable length of time. Dairying has developed to a considerable extent under the influence of this factory.

OGDEN.—The Ogden Sugar Company is operating a factory at this place of 350 tons capacity. This factory has been gradually overcoming the obstacles in its way, and during its last campaign succeeded in making a very favorable showing. The crop conditions in the early part of the season were quite unfavorable, but the results at the close were satisfactory. In this section alfalfa, potatoes, tomatoes, wheat, barley, oats, and rye are grown and rotated with sugar beets. Ogden is quite a center for the production and canning of tomatoes and the



production of potatoes. The tomato season comes about the time of the sugar campaign, and interferes to some extent in securing laborers and the delivery of beets in the early stages of the campaign. During the harvest of last fall I secured from a sugar-beet grower of this section the following table on the cost of production:

*Cost per acre of growing, harvesting, and delivering a crop of sugar beets.*

Rent .....	\$10.00
Preparing seed bed .....	1.25
Planting .....	2.20
Bunching and thinning .....	2.50
Cultivating .....	.75
Harvesting and delivering to the factory at a distance of 5 to 6 miles, based on 12 tons per acre, at \$1.25 per ton .....	15.00
Total .....	32.70

This factory under its contract must sell to the farmers 50 per cent of the pulp at 50 cents per ton. The rest of it is sold to a feed company under contract for 20 cents per ton. The factory pays \$4.50 flat per ton of beets, except for beets delivered by cars from a distance, in which case the farmers pay  $12\frac{1}{2}$  cents per ton on the freight. Considerable feeding is done at this place. It is also quite a dairying district. All of the pulp is very readily sold at the above price.

The beets during the campaign run about 13 per cent sugar and 80 per cent purity. The factory began operations September 14 and closed January 9. Crop conditions were fair. In growing sugar beets most of the farmers in this district practice subsoiling. They do not use the hoe to any considerable extent except at the time of bunching.

LOGAN.—The Logan Sugar Company is operating a factory at this place having a capacity of 400 tons. It began operations November 9 and completed its first campaign January 23. The crop conditions were fair. The factory had a very good season. The beets showed averages as follows: Sugar content, 13.8 per cent; purity coefficient, 82. The farmers rotate grain and alfalfa with sugar beets. There is also considerable interest in dairying.

#### COLORADO.

The State of Colorado has developed considerable interest in beet-sugar production. All beets grown in Colorado are produced by irrigation. Three of the factories in operation are demonstrating the adaptability of the industry to the agricultural conditions of the State. There are many other places where it can be introduced. Companies are organized for putting in factories at Greeley, Eaton, Longmont, and Lamar. There are quite a number of other enterprises in various stages of consummation.

GRAND JUNCTION.—The Colorado Sugar Manufacturing Company is

operating a factory here of 350 tons. This was the first factory constructed in Colorado and operated its third campaign last year. The locality is very much interested in fruit production. There has been quite an apathy on the part of the farmers in taking up with beet-sugar production, also an inclination to put their best lands, and those that have been under cultivation, into fruit trees. There has been too much of a tendency to grow sugar beets on new lands, in fact to open up these lands with the cultivation of this crop. As a natural consequence sugar-beet growing has not been a success, nor has the factory. These lands are very hard to reclaim, but respond well after having been under cultivation for some time. Sugar beets have never had a fair test. The probabilities are that the progress of the factory will be slow, but whenever it is given a fair chance by the farmers there is no reason why it should not succeed.

ROCKY FORD.—The American Beet Sugar Company is operating a factory here of 1,000 tons daily capacity. The water for irrigation is secured through ditches from the Arkansas River. This factory and the sugar-beet crop have been a success from the start. It is a locality which produces melons and alfalfa, and to some extent small grain. These crops they are rotating with sugar beets. The beets show a high content of sugar and purity. The factory operated its second campaign last year, beginning October 2 and closing January 18. The crop conditions were fair. The results of its last two seasons indicate that the factory will be successful.

SUGAR CITY.—The National Sugar Manufacturing Company is operating a factory (Pl. IV, fig. 1) here of 500 tons capacity. It began operations October 6 and closed December 20. The crop conditions were fair. This factory represents the typical results of establishing a sugar factory in the arid region. It was built out on the raw plain that had never produced any crop except a little grazing. It has now operated two years, and made a success with the beets grown on these new lands. The company owns about 12,000 acres. It is interested in a water reservoir near Leadville, known as Twin Lakes. These lakes are over 200 miles from the lands which they irrigate. Under the laws of Colorado the water in these lakes is measured by the State irrigation engineer and turned into the Arkansas River, and the company is allowed to take out of the same river, near the factory, the amount of water turned in from the lakes, less 5 per cent deducted for evaporation. The farming district produces beets of high quality and purity, and, as the land is gradually improving by cultivation, they are securing a good tonnage. Along with sugar beets they are introducing other crops incident to the agriculture of that section, and will gradually introduce dairying and stock feeding. Where three years ago existed nothing but a wild plain, to-day can be found this large sugar factory, cultivated lands growing all kinds of crops, and a town of 1,500 inhabitants.



FIG. 1.—FACTORY AT SUGAR CITY, COLO.



FIG. 2.—FACTORY AT MARINE CITY, MICH.





LOVELAND.—The Western Construction Company is operating a plant here of 1,000 tons daily capacity. It opened its campaign October 28, and closed March 5. The crop conditions were good. This factory is located in one of the oldest and best agricultural sections of the State. The principal agricultural interests are sheep and cattle feeding, and raising potatoes, alfalfa, and small grain. The locality has a good farming population. Most of the land growing sugar beets was subsoiled the first year. The average tonnage, sugar content, and purity of the beets were very high. This factory went through its first campaign last year. It made the best success of any factory up to this time for its first year's experience. The estimates for cost of growing sugar beets the first year under irrigation were from \$40 to \$45 per acre. Considering its feeding interests already established with the facilities for feeding alfalfa and grain, it is very likely that this factory will be able to dispose of its pulp at a fair price from the beginning.

## NEBRASKA.

Nebraska was one of the first States to go into the sugar manufacture. It has a loose, sandy loam soil, and under favorable rain conditions succeeds very well in the production of sugar beets. The cost of production of beets is probably lower in this State than in most others now growing them, on account of the ease with which the soil can be worked and kept in good condition.

GRAND ISLAND.—The American Beet Sugar Company is operating a factory at this place of 350 tons daily capacity. Year before last the beet growers around this factory were considerably discouraged by the appearance of diseases peculiar to the beet crop. Considerable loss was sustained thereby. During the past year these diseases were not serious in the locality, and the farmers produced a fairly good crop. The company operating this factory also has one at Norfolk, Nebr. The factory at Grand Island was not operated, and the beets produced there were shipped to Norfolk.

NORFOLK.—The American Beet Sugar Company is operating a factory here of 350 tons. The beets raised in this locality year before last also suffered seriously from beet diseases. While these diseases did not recur the past year to any considerable extent, the crop conditions were quite poor. The beets for the factory, however, came from Grand Island as well as from its own farming district, and they had a very good campaign, beginning October 7 and closing January 2.

These two factories of the American Beet Sugar Company have been in operation about ten years. They have had a great many drawbacks in that time, caused by droughts, beet diseases, and disinclination of the farmers to cooperate with them, but they are gradually overcoming these difficulties, and will probably work in the future under more favorable conditions. The factory at Norfolk is run by working two

sets of hands in shifts of twelve hours, thus using twenty-four hours per day, the laborers receiving from 15 to 19 cents per hour.

LEAVITT.—The Standard Beet Sugar Company is operating a factory here of 500 tons daily capacity. Most of the beets are grown on the farms of the Standard Cattle Company. This is one of the largest feeding concerns in the United States. At present it is feeding about 35,000 head of lambs and 4,000 head of cattle. The feeding company experimented with pulp to discover its desirability in fattening sheep and cattle. As a result it promoted the organization of the beet-sugar company, many of those interested in the cattle company taking stock in the sugar company, the prime object being to secure the pulp for the stock-feeding enterprise. The pulp question was settled with this factory in its inception. The combination of these two enterprises is very favorable to both.

The factory operated its second campaign last year beginning September 21 and closing December 7. The lands upon which the beets are grown are of heavy, rich, bottom loam. Beet growing has met with many difficulties in the way of floods, wet seasons, diseases, and insect pests. The lands themselves are among the best that can possibly be used for this crop. The factory has been unfortunate in two unfavorable years. Under normal conditions it will probably succeed well. The crop conditions for the past year were below the average. It opened its campaign September 21 and closed December 7.

#### MINNESOTA.

The State of Minnesota has conducted many experiments with sugar beets. Their averages of sugar content, purity, and tonnage have always been quite favorable. The State has accomplished a great deal in dairying and raising small grain, especially wheat. Sugar beets afford a new resource for rotation. The crop is grown on prairie lands, largely sandy loams, fertile and easy to work.

ST. LOUIS PARK.—The Minnesota Sugar Company is operating a factory at this place of 350 tons daily capacity. The crop conditions were fairly good in this section during the past year. The factory began operations September 24 and closed its third campaign December 25. It has been unfortunate in having droughts the first two years. The farmers gained a good illustration of the value of the sugar-beet crop in that it succeeded better than most other crops. This company has had difficulty in getting the farmers interested. It has been compelled to go into Iowa and contract for a considerable part of its beets. The farmers in their own locality during the past year, however, grew most of the beets for the factory. The locality possesses many favorable conditions for the sugar industry. It has good home markets, good railroad facilities, cheap fuel, and good limestone. The company may be credited with having fairly overcome most of the difficulties, and in the future will probably be successful.



MICHIGAN.

The State of Michigan had 13 factories in operation the past year, their total nominal capacity being 6,600 tons of beets daily. Four years ago one factory was installed, and the rest of them have been put in operation since that time. The sugar industry in the State is quite illustrative of its introduction in this country. When the industry was started comparatively little was known in the State about the production of sugar beets, or the manufacture of sugar from them. The companies installing these factories were organized, capitalized, and built while the crops were being grown for their campaigns. Each of them began with little or no information, and both manufacturers and farmers derived what they know to-day from actual experience. In addition to those already in operation, four more factories are being built in the State to enter the campaign of 1902, as follows:

*New factories in Michigan.*

Sebewaing Sugar Company, at Sebewaing .....	tons..	600
Valley Sugar Company, at Saginaw.....	do....	600
Croswell Sugar Company, at Croswell .....	do....	600
McComb Sugar Company, at Mount Clements.....	do....	600
		<hr/>
Added daily capacity for next season .....	do....	2, 400
Present daily capacity .....	do....	6, 600
		<hr/>
Total daily capacity for next season.....	do....	9, 000
Investment in plants by September 1, 1902.....		\$9, 000, 000
Working capital by September 1, 1902. ....		\$1, 500, 000
		<hr/>
Total investment by September 1, 1902 .....		\$10, 500, 000

These factories report crop conditions as follows: Five "fair," five "average," two "good," and two "poor."

Thirty other enterprises are organizing to build factories for the campaign of 1902 or 1903.

At the close of the last campaign the Michigan Sugar Manufacturers' Association compiled a report giving statistics of the Michigan beet-sugar industry for the year ending February 15, 1902, which is as follows:

FACTORY STATISTICS.

*Beet-sugar factories of Michigan.*

No.	Factories.	Location.	Daily capacity.
			<i>Tons.</i>
1	Michigan Sugar Co.....	Bay City.....	500
2	Bay City Sugar Co.....	Bay City.....	600
3	West Bay City Sugar Co.....	West Bay City.....	500
4	German-American Co.....	Salzburg.....	400
5	Saginaw Sugar Co.....	Saginaw.....	600
6	Alma Sugar Co.....	Alma.....	600
7	Lansing Sugar Co.....	Lansing.....	600
8	Peninsular Sugar Refining Co.....	Caro.....	600
9	Detroit Sugar Co.....	Rochester.....	500
10	Marine City Sugar Co.....	Marine City.....	350
11	Holland Sugar Co.....	Holland.....	350
12	Wolverine Sugar Co.....	Benton Harbor.....	500
13	Kalamazoo Sugar Co.....	Kalamazoo.....	500
Total .....			6, 600

The investment in plants on the basis of \$1,000 for each ton of daily capacity is \$6,600,000. The working capital on the basis of \$100,000 for a 600-ton plant is \$1,100,000. This working capital is used in making repairs, purchasing seed, assisting farmers, carrying sugar, and paying labor during the period between campaigns.

Total investment by Michigan sugar companies, \$7,700,000.

#### AGRICULTURAL STATISTICS.

Acres beets harvested.....	66, 400
Contractors or families raising beets .....	16, 848
Acres per contract.....	3. 9
Tons beets raised at 9 tons per acre .....	597, 600
Average per cent sugar in beets.....	14. 1
Value of average ton of beets.....	\$5. 20
Amount paid farmers for beets .....	\$3, 107, 520

#### LABOR REQUIRED TO RAISE AND MARKET BEETS.

Days for man and team plowing on each contract.....	2
Days for man and team fitting on each contract .....	4
Day for man and team seeding on each contract .....	1
Total days for man and team putting in beets on each contract .....	7
Total days for man and team putting in beets on entire crop.....	117, 936
Days (April 15 to June 1) used in putting in crop.....	45
Days' work for 2,621 men and teams putting in entire crop.....	45
Days' work for one man to block and thin one acre.....	4
Days' work for one man to block and thin entire crop .....	265, 600
Days (May 15 to July 1) used in blocking and thinning crop .....	45
Days' work for 5,902 men to block and thin entire crop .....	45
Days' work for man and horse cultivating one acre .....	2. 5
Days' work for man and horse cultivating entire crop.....	166, 000
Days (June, July, and August) used in cultivating crop.....	90
Days' work for 1,844 men and horses cultivating entire crop.....	90
Days' work for man to hoe one acre .....	3
Days' work for one man to hoe entire crop.....	199, 200
Days (July and August) used in hoeing crop .....	60
Days' work for 3, 320 men to hoe entire crop .....	60
Days' work for man and team to lift one acre.....	5
Days' work for one man and team to lift entire crop .....	332, 000
Days (October) used in lifting crop .....	30
Days' work for 1,106 men and teams to lift entire crop .....	30
Days' work for one man to top and pit one acre .....	5
Days' work for one man to top and pit entire crop.....	332, 000
Days (October) used in topping and pitting crop .....	30
Days' work for 11,066 men to top and pit entire crop .....	30
Days' work for man and team to haul one acre .....	2
Days' work for one man and team to haul entire crop .....	132, 800
Days (Oct., Nov., Dec., and Jan.) used to haul crop.....	120
Days' work for 1,107 men and teams to haul entire crop.....	120

#### *Summary of men and teams employed in raising beets during summer and fall of 1901.*

From April 15 to June 1, 2,621 men and two-horse teams putting in crop.

From May 15 to July 1, 5,902 men blocking and thinning.

From June 1 to September 1, 1,844 men and single horses cultivating.

From July 1 to September 1, 3,320 men hoeing.

From October 1 to November 1, 1,106 men and two-horse teams lifting.

From October 1 to November 1, 11,066 men topping and covering.

From October 1 to February 1, 1,107 men and two-horse teams hauling.

In estimating the cost of raising and marketing the crop the rate of wages is considered as follows:

For man, \$1.37½ per day.

For man and single horse, \$2 per day.

For man, two horses, and tools, \$2.75 per day.

At the above rate the cost of labor for raising the beets averages \$33.25 per acre and amounts to a farmers' pay roll of \$2,208,382. To this should be added a rental value of land at \$5 per acre, making \$38.25 as the actual cost of raising an acre of beets. The average yield for Michigan is 9 tons per acre. The average cost to farmers per ton is \$3.70. The average returns to the Michigan farmer is 9 tons at \$5.20 per ton or \$46.80, from which should be deducted the cost of 15 pounds of seed at 15 cents per pound or \$2.25, leaving net to the farmer \$44.55, or a profit of \$6.30 per acre over the cost of labor and land rental. If the farmer ships his beets to the factory the freight must be deducted from his \$6.30 profit, leaving the final net profit still less.

The above estimate shows 26,966 men, 1,844 single horses, and 4,834 double teams employed during the season. It makes no allowance for bad weather or any of the accidents attendant upon the business. Every man and every team is expected to work every day. The above figures are the minimum. In actual practice, to determine the number of men and teams employed the total should be increased in each case 25 per cent. This increase does not mean a corresponding increase in cost of producing beets, as the men and teams are not under pay during unfavorable weather. Increased thus, the number of men and teams finding employment in raising beets for Michigan factories during the summer and fall of 1901 is as follows: Men, 33,707; single horses, 2,305; double teams, 6,042.

The actual number of contractors raising beets for Michigan factories during the summer and fall of 1901 is 16,848. This represents the same number of farmers' families, and, on a basis of 5 members to a family, represents 84,240 persons actually interested in the agricultural side of the beet-sugar industry of Michigan.

SUPPLIES FOR AN AVERAGE MICHIGAN FACTORY, RATED DAILY CAPACITY 508 TONS, AND ACTUALLY CUTTING 46,000 TONS IN ONE HUNDRED AND FIVE DAYS.

Coal—9,660 tons, at \$2.50 per ton .....	\$24, 150
Lime rock—3,220 tons, at \$2 per ton .....	6, 440
Coke—354 tons, at \$5.25 per ton.....	1, 858
Sulphur—21,000 pounds, at 2½ cents per pound .....	472
Filter cloth—8,350 yards, at 15 cents per yard .....	1, 252
Oils—2,000 gallons, at 25 cents per gallon .....	500
Waste—1,550 pounds, at 5 cents per pound.....	78
Chemicals .....	1, 885
Osmose paper—7,600 sheets, at 10 cents.....	760
Sugar bags—19,300, at 9 cents each .....	1, 737
Cooperage stock—24,134 barrels, at 26½ per barrel .....	6, 355
Barrel linings—24,134, at 2½ cents per barrel.....	603
Miscellaneous, including stationery, blank books, printing, postage, telegrams, telephones, sugar reports, Dun's reports, and traveling expenses..	2, 500
Total .....	48, 590

This amount, estimated on 46,000 tons, the average cut of a 500-ton plant for one hundred and five days, is \$1.06 per ton of beets.



## CAMPAIGN.

The combined daily capacity of the 13 Michigan factories is 6,600 tons.

To cut this year's supply of beets would require all these factories to run to their utmost capacity, ninety and one-half days, without any allowance for shut downs or accidents. The actual average running time for all Michigan factories during the current year is one hundred and five days of twenty-four hours each, which is the same as three hundred and fifteen days of eight hours each, the customary hours run each day by factories in other lines of business. In addition to the one hundred and five days actually used in cutting beets, each factory is obliged to have a full quota of men for a week before beginning to cut beets, and half its quota for ten days after stopping the cutting of beets. This is the same as lengthening the campaign to one hundred and seventeen days with a full force of men. Steam is kept on half the boilers for a period of six weeks exclusive of the one hundred and five days' campaign.

The average rated daily capacity for each Michigan factory is 508 tons. The actual average daily capacity on the basis of one hundred and five days' campaign is 438 tons, or 86.2 per cent of the rated capacity.

## LABOR.

During the campaign of one hundred and five days there are employed in a 500-ton factory the following men, half of whom are on each twelve-hour shift. Owing to the work done just before and after the cutting of beets, the actual campaign for the full force is one hundred and seventeen days:

Salaried persons at \$135 per month .....	12
Skilled workmen at \$2.25 per twelve hours .....	57
Common laborers at \$1.80 per twelve hours .....	137
Actual amount paid for labor and salaries during campaign of one hundred and seventeen days (this plant cuts 46,000 tons beets).....	\$50, 310
Average cost of labor during actual campaign per ton of beets.....	\$1.09

During the eight months intervening between campaigns there are employed 12 salaried persons at \$135 per month, 10 skilled workmen at \$60 per month, and 8 common laborers at \$40 per month.

Salaries and wages paid during the eight months intervening between campaigns .....	\$19, 360
Total amount paid for salaries and wages during entire year .....	\$69, 670
Average cost of labor during entire year per ton of beets.....	\$1.51
Amount paid for labor by the 13 Michigan sugar factories during entire year.....	\$902, 376
Men employed in the 13 Michigan sugar factories.....	2, 678

## REMARKS.

From the experience of Michigan factories it is found that for the four months of the campaign the repairs, exclusive of labor, on a 500-ton plant are \$750 per month, or \$3,000 for the campaign. It is also found that the repairs during the off season of eight months amount on an average to \$12,000, exclusive of labor. All these plants are new, the oldest (Michigan Sugar Company) being but four years old. As time advances the repair account will materially increase. At the present time such repairs, exclusive of labor, amount to 32 cents per ton of beets sliced.

Notwithstanding the above-mentioned expense for repairing breakage, there is a depreciation resulting from the fact that sugar machinery is run continually, night and day, for four months, and is then allowed to stand idle for eight months, giving an opportunity for corrosion. Further, the machinery is going out of date, and new

and improved machinery must be purchased to take its place. The changes in methods and machinery are rapid, compelling the companies to make extensive changes from time to time to keep the cost of manufacture within the limits established by competition. It is believed that a conservative estimate of the cost of such changes and depreciation is 7 per cent of the first cost of the plant. On a 500-ton plant this item amounts to \$35,000 per year, which, added to the cost of repairs resulting from breakage, makes \$50,000, or \$1.09 per ton of beets sliced by such Michigan factory during the present season.

#### INTEREST—TAXES—INSURANCE.

The investment and working capital of a 500-ton plant amount to \$600,000. At 5 per cent the interest on the same is \$30,000.

The assessed valuation on a 500-ton plant, exclusive of bonded indebtedness, is \$300,000. The average rate of State, county, school, and municipal taxation combined is 3 per cent, or \$9,000.

The amount of insurance carried on a 500-ton plant is usually \$200,000; the rate 85 cents.

The amount of insurance carried on sugar in warehouses at factory and elsewhere varies, but is usually about \$75,000 for six months; the rate 1 per cent for six months.

The employers' liability insurance against accident to workmen is estimated at \$4 per \$1,000 of annual pay roll. This pay roll in a 500-ton house amounts to \$69,670, making this insurance cost \$280 per year.

Boiler insurance in a 500-ton house is usually carried at \$40,000; rate one-third per cent per year; cost of premium, \$133.

Total yearly cost of all kinds of insurance carried by a 500-ton sugar plant, \$2,913.

Amount paid annually for interest, taxes, and insurance in a 500-ton sugar house, \$41,913; which estimated on the tons beets sliced during the present season is 91 cents per ton.

#### BROKERAGE.

All sugar is sold by brokers at the uniform rate of 10 cents per barrel or 3 cents per sack. This expense of 3 cents per hundredweight of sugar is borne by the manufacturer. On the output of a 500-ton plant this item amounts to \$2,898 per year, or 6.3 cents per ton beets sliced.

#### OUTPUT OF SUGAR.

The average output of sugar per ton of beets at the Michigan factories is 210 pounds, which for the present season amounts to 125,496,000 pounds, or 62,748 tons, or 4,183 carloads of 15 tons each. This amount would make a solid train load of sugar 31.6 miles long.

This amount is 75 per cent of Michigan's yearly consumption of sugar. Its value at  $4\frac{1}{2}$  cents per pound is \$5,647,320.

#### COST OF MANUFACTURING SUGAR IN MICHIGAN.

Cost of 1 ton beets .....	\$5. 20
Cost of supplies per ton beets .....	1. 06
Cost of labor for entire year per ton beets .....	1. 51
Cost of repairs and depreciation per ton of beets .....	1. 09
Cost of interest, taxes, and insurance per ton of beets .....	. 91
Cost of selling sugar per ton of beets .....	. 063
Total cost per ton of beets .....	9. 833
Total cost per 100 pounds refined sugar .....	4. 682

The above estimate includes 5 per cent interest on the total capital invested and 7 per cent annual depreciation on the value of the plant. Leaving out these two

items the cost of manufacturing each 100 pounds of refined sugar is reduced \$0.671, or to \$4.011.

\* \* \* \* \*

#### BY-PRODUCTS.

The only by-product at present from which Michigan factories derive any income is the final molasses, which equals in gross amount 3 per cent of the weight of beets. Eight factories are now selling this molasses at \$2 per ton f. o. b. at the factories. The amount received is not sufficient to pay the expense of wasting the pulp, which expense has not been included in the above estimate. The Bay City Sugar Company last year built a pulp-drying plant at a large expense in order to make pulp merchantable. The experiment was a complete failure. The Alma Sugar Company is this year trying a similar experiment, and hopes to test its pulp drier before the close of the season. The result is entirely problematical.

#### BEET SEED.

On account of the fact that the beet-sugar industry in the United States is of such recent development it is necessary to import all the seed from Europe. This seed is purchased by the factories in the month of December, distributed to the farmers in April, and paid for by the farmer from the sale of beets in the late fall. Sugar companies are thus obliged to advance money for the cost of seed, paying interest on the same for from eight to ten months.

#### BEET CONTRACTS.

Contracts with farmers for the growing of beets for the campaign beginning October, 1902, have already been made by all the factories at the old price of \$4.50 per ton for beets testing 12 per cent sugar, and an additional  $3\frac{1}{2}$  cents for each one-tenth of 1 per cent above 12. As the average Michigan beet tests 14.1 per cent, the actual price paid by factories is \$5.20 per ton.

#### RAILROADS.

All the coal, lime rock, coke, machinery, general supplies, sugar, and 50 per cent of the beets are hauled by railroads. The total amount of incoming and outgoing freight averages at each factory \$1 per ton of beets sliced; or for the State at large it amounts to \$597,600 for the present year. The valuation of Michigan's output of sugar for the present year at  $4\frac{1}{2}$  cents per pound is \$5,647,320, all of which goes into circulation and is widely distributed. This is but 75 per cent of the present consumption of sugar in Michigan. If there were no sugar factories in the State this \$5,647,320 would all leave the State, and a large per cent of it go to foreign countries. By keeping it at home money is easier, general business better, and traffic upon railroads greatly increased.

Last year the Michigan Central Railroad extended one of its branches 20 miles especially to provide beets for the Peninsular Sugar Company at Caro. Several similar extensions have been planned for next season in order to develop new beet tracts.

#### AGRICULTURAL IMPLEMENTS.

The development of the American beet-sugar industry necessitates an entirely new class of agricultural tools and machinery, among which may be mentioned beet-seed drills, beet cultivators, beet hoes, beet pullers, beet knives, and beet forks. It has also increased the use of wagons, plows, and harrows. As yet few labor-saving tools have been invented. The industry is of too recent origin.



## MACHINERY.

All the machinery in Michigan sugar factories is of American make and put up by American workmen. The machinery in the earlier Western factories was of German make.

## CULTIVATION OF BEET CROPS.

Beets require better preparation of the soil and more careful attention than does any other crop. Wherever farmers undertake the culture of the beet it results in improved methods of farming and helps establish farming upon a scientific basis.

## WISCONSIN.

The State of Wisconsin, through its experiment station, has probably carried on more experimentation with sugar beets than has any other State in the Union. These experiments have covered the entire State, and have been well done, practically and scientifically. They cover a series of years, and demonstrate quite thoroughly the favorable conditions for growing sugar beets in many sections. The State has extensive dairy and creamery interests.

MENOMONEE FALLS.—The Wisconsin Sugar Company is operating a factory here of 500 tons daily capacity. Four years ago a factory was established at this place of 350 tons daily capacity. Unfortunately it was not a success. It was built and equipped more along theoretical than practical lines. The farmers grew a large crop of beets for its first campaign, but it was late in construction, and the beets deteriorated to such an extent that they were unfit for the production of sugar. The factory started up and ran for a few days; then it closed down and went into the hands of a receiver, where it remained until last year, when it was refitted and improved at considerable expense. Its campaign began November 1 and closed January 20. The crop conditions were reported poor, yet the district produced a tonnage equal to the average of the United States. The sugar content averaged 14.8 per cent and the coefficient of purity 82.3.

There are five or six organizations in the State ready to install factories at different points. It appears quite probable that within the next two or three years Wisconsin will be an important sugar-producing State.

## OHIO.

This is another State that has carried on extensive experiments covering a series of years. These have indicated favorable conditions in the State for sugar-beet culture. The agriculture in the State of Ohio is quite general, and it is well adapted to the introduction of the sugar-beet crop and the manufacture of sugar. The good quality of cheap fuel, facilities for transportation, and home markets are favorable to cheap production. The State has a great many small farms. Experience has shown that small farmers succeed better and quicker in

the beginning with growing sugar beets than the larger farmers farther west.

FREMONT.—The Continental Sugar Company is operating a factory here of 350 tons daily capacity. It began operations October 14 and closed December 18. The crop conditions were poor. The factory has been unfortunate in having two bad years. Farming has been so well and long established with other crops, that it has been quite difficult to get the farmers to take up with sugar-beet growing. The prospects are improving in this direction, however. It is hoped that the factory has passed over its experimental period, and that it will during the coming year enter on a successful career.

#### NEW YORK.

The State of New York has spent more money for experimentation in sugar beets than any other State. Experiments have been conducted at both the experiment stations. Under Director Roberts, of Ithaca, these experiments were elaborate and comprehended a thorough test of the soil, the best methods of cultivation, selection of seed, and everything in fact that pertains to the success of the beet crop. The lower half of the State is quite generally well adapted to the crop. New York has large dairying and creamery interests and does a great deal of gardening. Farmers are well posted on the value of feeding by-products to dairy cattle. The State has a good quality of cheap fuel, reasonable transportation facilities, and an extensive market for the product. Organizations have been effected at many places, and it looks quite probable that factories will be built in many other sections of the State.

ROME.—Four years ago a factory was built at this place of 200 tons daily capacity. It was a factory of foreign make and old in design. It struggled along through two campaigns and discovered that it had not the capacity or equipment to produce sugar cheap enough to meet competition in the market. It was unfortunate the first year in the selection of its seed, securing a kind that produced beets low in sugar content and purity. This had much to do in discouraging the farmers and those interested in the factory. After working its second campaign it closed down, was finally sold out, and most of the machinery was moved away to be put into use for other purposes.

BINGHAMTON.—The Binghamton Beet Sugar Company is operating a factory here of 600 tons daily capacity. This was the second factory built in the State. It was also foreign in make and design. It had many things to contend with in the beginning, especially the lack of interest on the part of the farming community. It has operated three campaigns, beginning the last one November 5 and closing January 17. It has gradually ingratiated itself into the sympathy of the farming element, and its success is quite assured. Last year it

installed new machinery and improved its equipment sufficiently to raise its daily capacity to 600 tons. From the start it has been able to dispose of its pulp at from 50 cents to \$1 a ton.

LYONS.—The Empire State Sugar Company is operating a factory here of 600 tons daily capacity. This was the third factory built in the State, working its first campaign last year, beginning October 16 and closing December 22. The crop conditions were fair. The average sugar content of the beets delivered to the factory was 13.6 per cent and the coefficient of purity 84.9. For a first year's campaign it was fairly successful.

#### NEW MEXICO.

New Mexico has carried on many experiments in sugar-beet growing under the direction of the Territorial experiment station, also by local societies at various points. It has been found that there is quite a number of valleys which possess the conditions requisite for growing sugar beets.

CARLSBAD.—Five or six years ago a factory was established at this place having a daily capacity of 200 tons of beets, which was operated by the Pecos Valley Beet Sugar Company. This factory was located at a town called Eddy, the name of which has been recently changed to Carlsbad. The machinery was of foreign make and design. It appeared to do quite well, but for some reason has been closed down during the past two years, and the lands growing sugar beets have been put into alfalfa and other crops.

#### ILLINOIS.

The State experiment station of Illinois has also carried on extensive experimentation with sugar beets and investigated the conditions for growing this crop. Local organizations and societies have been established at various places in the State, and numerous plats of land have been secured and planted to sugar beets. These plats have been supervised by experts and a careful history kept of everything pertaining to the experiments. It has been thoroughly demonstrated that many parts of the State of Illinois possess the conditions for successfully growing beets of good tonnage, purity, and sugar content. There are many organizations and capitalists planning to erect sugar factories at various points in the State.

PEKIN.—The Illinois Sugar Refining Company constructed a factory at this place having 700 tons daily capacity. This factory was built by parties who have been interested in the manufacture of glucose. It was discovered, after operating one campaign, that it would take some time to get the farmers worked up to the point of producing beets sufficient for the factory's needs. An additional equipment was placed in the factory for the manufacture of glucose during the past year.



The beets that were grown for the campaign were sold to the factory at Benton Harbor, Mich., and the Pekin factory has ceased to manufacture beet sugar and has undertaken the production of glucose. Whether or not this is to be permanent has not been made known.

#### METHODS OF GROWING BEETS.

It is difficult to lay down general directions and rules for growing sugar beets applicable to all localities and conditions. Often expert sugar-beet growers, at public meetings and through the agricultural press, give minute directions covering all the details of this intricate process. Others, each well versed in the process of growing sugar beets, get into arguments and disputes as to the right method. In such cases each may be correct in a measure. The occasion for such disagreements lies in the fact that each person has in mind the right method for a particular locality or set of conditions. A careful study of the different sections of the United States where sugar beets are grown will lead to the conclusion that there is no single road to success in growing sugar beets. Every locality has settled conditions which will materially modify any set of methods that might apply to some other one. There are some settled rules, of course, but to a great extent the various agricultural districts of this country will have to work out each for itself the right method. The person who argues that the ground must be plowed in the fall, in order to receive the benefit of winter frost, is not offering any argument to the Pacific coast, for instance, where many beets are grown. And he who insists that the ground should be rolled in all instances after planting will hazard the crop if his directions are followed in many parts of Nebraska and other sections where the soil is sandy and there are strong winds. In such case a smooth surface offers an excellent opportunity for the wind to carry along the sharp grains of sand, cutting off the plants and destroying the crop.

There can be no general fixed rules regarding the kinds and application of fertilizers. General principles are all right when accompanied by the reasons underlying, but must always be modified to meet local conditions.

With the development of the industry in all the sections which have the necessary conditions, and the acquirement of ample experience both by the farmers in the production of beets and by the manufacturers in the making of sugar, there will come many improvements and eventually a cheapening of production, a result of great importance to all concerned in the success of the industry, because eventually the beet-sugar industry of the United States will have to meet a sharper competition with foreign sugar producers.

There are some things settled, however, about growing sugar beets. It will generally be conceded that the ground should be plowed deep,

and in most instances subsoiled. Before the seed is planted the ground must be thoroughly pulverized by harrowing and by rolling, even if the surface has to be afterwards roughened. Advantage must be taken of the general and prevalent rain conditions. The ground must be moist enough to germinate the seed, either by rainfall or irrigation. Rainfall is best when it can be obtained. In some localities either is used, according to circumstances. Seeds are planted at depths of from one-half to 2 inches, according to the prevailing conditions in the particular locality. The beets must be planted near enough together to produce a beet of a certain size. This spacing depends again upon the locality and the nature and fertility of the soil. The size and quality of the beet depend materially on the right kind of spacing. The beets must be thoroughly cultivated, hoed, and hand weeded, because cultivation tends to conserve the moisture of the soil, and clean fields permit favorable action of sun and air. The sooner the beet is harvested after it is ripe the better, because further rainfall may start a new growth, producing new lateral roots and new leaves, thus greatly reducing the sugar content and purity of the beets.

#### PREPARING THE SEED BED.

The preparation of the soil for receiving the seed is one of the intricate and expensive parts of the work. The first prerequisite is the selection of the land itself. Sugar beets are a vigorous crop and require a good soil. The old idea that sugar beets can be grown on soil that has been worn-out has been pretty thoroughly exploded, and the sooner it is wholly abandoned the better it will be for the sugar-beet growers as well as for the manufacturers. One of the first errors that the farmers of Michigan fell into was to take their worn-out grain lands and attempt to grow sugar beets on them. The results were quite disastrous but conclusive, and the Michigan farmers are now setting apart their best lands for this purpose. Every old agricultural district in which the industry has been established had to go through this experience. It should be insisted upon that a good, fertile soil is required. Sugar beets will grow in sandy soils, sandy loams, or clay loams if not underlaid with hardpan, but they must be fertile.

Having selected the land, deep plowing is usually required, and in many instances subsoiling is necessary. The main body of the beet should rest in the part of the soil that has been stirred. This prevents the beet from tending to grow up out of the ground and gives a better opportunity for its fine lateral roots to perform their functions.

After the ground has been plowed it should be thoroughly pulverized by disking, harrowing, rolling, and planking. It is not necessary to use all of these methods at once, but enough of them must be used to accomplish the end in view, and that is to thoroughly pulverize the ground. The surface should be left perfectly soft and as smooth as



possible. Special implements are being constantly devised to accomplish this work. The sugar-beet grower can select the implement or implements that perform this service best according to his own needs and conditions.

#### PLANTING.

The soil being ready, the beets are planted (Plate V, fig. 1) at different depths varying from one-half inch to one and one-half inches, according to the peculiar needs of the soil and the peculiar conditions existing in the soil at the time of planting. This is usually governed by the amount of moisture it contains, the time of year the planting is done, and the tendency of the soil to dry out. Four rows are usually planted at one time. They are usually from 14 to 24 inches apart, depending upon the strength of the soil, whether irrigation is used or not, and, if used, how it is applied. About 20 pounds of seed are used per acre. The seeds are planted from one-fourth to one-half an inch apart in the rows.

The usual price for seed is 15 cents per pound, and the cost per acre at this rate is \$3. It will be noted, when we come to the subject of bunching and thinning, that only a small percentage of the seed planted is utilized in the end. In view of the great importance of securing a "stand," this apparent waste of seed seems necessary. Attempts are being made to reduce this item of expense. Some parties have invented a planter that will place the seeds in bunches in the row, the right distance apart, subject to regulation by the planter, instead of sowing them along the row as at present. Another experimenter has adopted the plan of first germinating a seed in a little package filled with soil rich in plant food. After the roots appear through the package, it is deposited by a specially devised planter at the proper place in the row. It is claimed for this process that the moisture in the package will carry the plant along until it has time to take root in the ground. It is also claimed that the well-balanced fertilizer in the package will make a strong, healthful plant in the beginning; also that, while it is a little more expensive in the start, it accomplishes four important purposes: (1) It gives early vigor to the plant; (2) it eliminates the excessive expense for seed; (3) it does away with bunching; (4) it does away with thinning. There can be no doubt that these are four very strong recommendations. If this new method proves a success, it will reduce the cost of growing beets at least one-fifth.

#### GERMINATION.

If the soil is in proper condition, the temperature favorable, and moisture sufficient, within a week after planting the beets will appear. By irrigation the moisture can be controlled to some extent, but, in the main, weather conditions must be depended on. Hot, dry winds





FIG. 1.—PLANTING SUGAR-BEET SEED, OXNARD, CAL.



FIG. 2.—HOEING SUGAR BEETS, OXNARD, CAL.





FIG. 1.—THINNING BEETS, OXNARD, CAL.



FIG. 2.—CULTIVATING BEETS, OXNARD, CAL.





soon reduce the moisture near the surface where the beet seeds lie. Cold weather retards germination. This germinating period of the sugar-beet plant is the most critical point in its existence, and one on which the farmer must be well posted. If a rain follows planting and bakes the ground, he must know how to overcome the difficulty. He must be thoroughly versed in the use of the harrow in connection with the sugar-beet crop. The old adage, "a stitch in time saves nine", is nowhere more applicable than here. The grower must begin the battle against the plant's enemies—weeds and grasses—immediately with the germination of the beet seed.

#### BUNCHING AND THINNING.

When the plant has three or four leaves, the bunching must be done. The grower passes down the row, and, with a stroke of the hoe, cuts out a part of the plants, leaving bunches from 6 to 10 inches apart.

After bunching, or when it is fairly under way, the laborers begin the thinning. This is accomplished by crawling along the row, and with the hands extracting from each bunch the excess of plants, leaving a single one. (See Pl. VI, fig. 1.) The thinning time is also a critical period. Should it rain, or the farmer be lacking in help, serious consequences may occur. The beet plants are growing near each other, and in many instances they are twining around each other. They have begun sending out lateral roots. If thinning is not done at the right time and with care, the plants left standing are sure to suffer damage.

#### CULTIVATING.

The first cultivation is performed in the bunching and thinning, when the operator presses the dirt firmly around the beet plant, and extracts whatever grass or weeds may be present. The second cultivation is done with the cultivator. (Pl. VI, fig. 2 and Pl. VIII). Four rows are usually cultivated at once. The seeder usually plants four rows at once, and the cultivator is run over the same four rows. The driver has only to watch a single row, since any crook in that row will also be found in the other three. The first cultivation is done with sharp, flat knives which run parallel with the surface, cutting off the roots of grass and weeds just below the surface. The cultivator is followed by a laborer with a hoe, who mellows the ground around the beets and draws the dirt up to them.

The next cultivation is usually done with slender, long plow blades, known as "bull tongues," that stir the ground down several inches. This is after the plants have reached some size. Cultivation is continued as the necessities of the case require. Cultivation has two ends in view: (1) To keep the grass and weeds thoroughly removed; (2) to form a dust mulch around the plants to conserve the moisture

in the soil. The cultivator is usually drawn by a single horse or mule and handled by one person.

Cultivating ceases when the plants are large enough to thoroughly shade the ground, and when to continue the work among them with a plow and horse would be detrimental. After that the workmen go over the field and pull out the grass and weeds by hand. (Pl. VII).

Cultivation is one of the most important things in growing sugar beets. Upon thoroughness in keeping down the weeds and grass depends the access of air and light. Light and heat are the active agents in the elaboration of sugar in the beet. The moisture necessary to the growth of the beet also depends a great deal upon cultivation. The influence of cultivation is recognized by the laborers of foreign descent in our sugar-beet fields, who are continually saying: "We have to hoe the sugar into the beets." (See Pl. V, fig. 2).

#### HARVESTING.

When one is accustomed to seeing sugar-beet fields, it is easy to determine when they are ripe. However, this point is usually determined by ascertaining the sugar content and purity of the beets. When a field of beets is ripe, the leaves tend to droop, and the whole field takes on a yellow appearance, which can not be mistaken by one accustomed to deciding the period of ripeness.

Harvesting is done with plows, of which there are several kinds. One has a sharp shear that cuts off the tap roots, and a long, slim mold-board which raises the beets several inches along with the dirt. Another harvesting implement has two prongs with diverging points. These prongs pass along through the soil at some distance below the surface, one prong on either side of a row of beets. The action of the implement is to break off the tap root, lift the beet up a few inches, and allow it to drop back as the plow passes on. Both of these instruments are called "diggers." The digger is followed by laborers who lift the beets and cleave off the tops with sharp knives. This is called topping. The beets are thrown into piles at regular distances, and the tops, with adhering crowns, are allowed to lie in the fields. (See Pl. IX.) The best practice is to plow them under as fertilizer, but in many cases they are fed to stock, or the stock is turned in on them. Sometimes these tops are hauled to market and sold by the load as hay or other forage.

#### DELIVERING BEETS.

Wagons are driven into the fields, and the beets are either thrown into the open boxes or are put in sacks. Sometimes a net is placed in the wagon, and when the wagon arrives at the factory the whole load of beets is lifted out by machinery. There is as yet no uniform method of unloading beets. The most common practice is to simply shovel





WEEDING BEETS, AMES, NEBR.





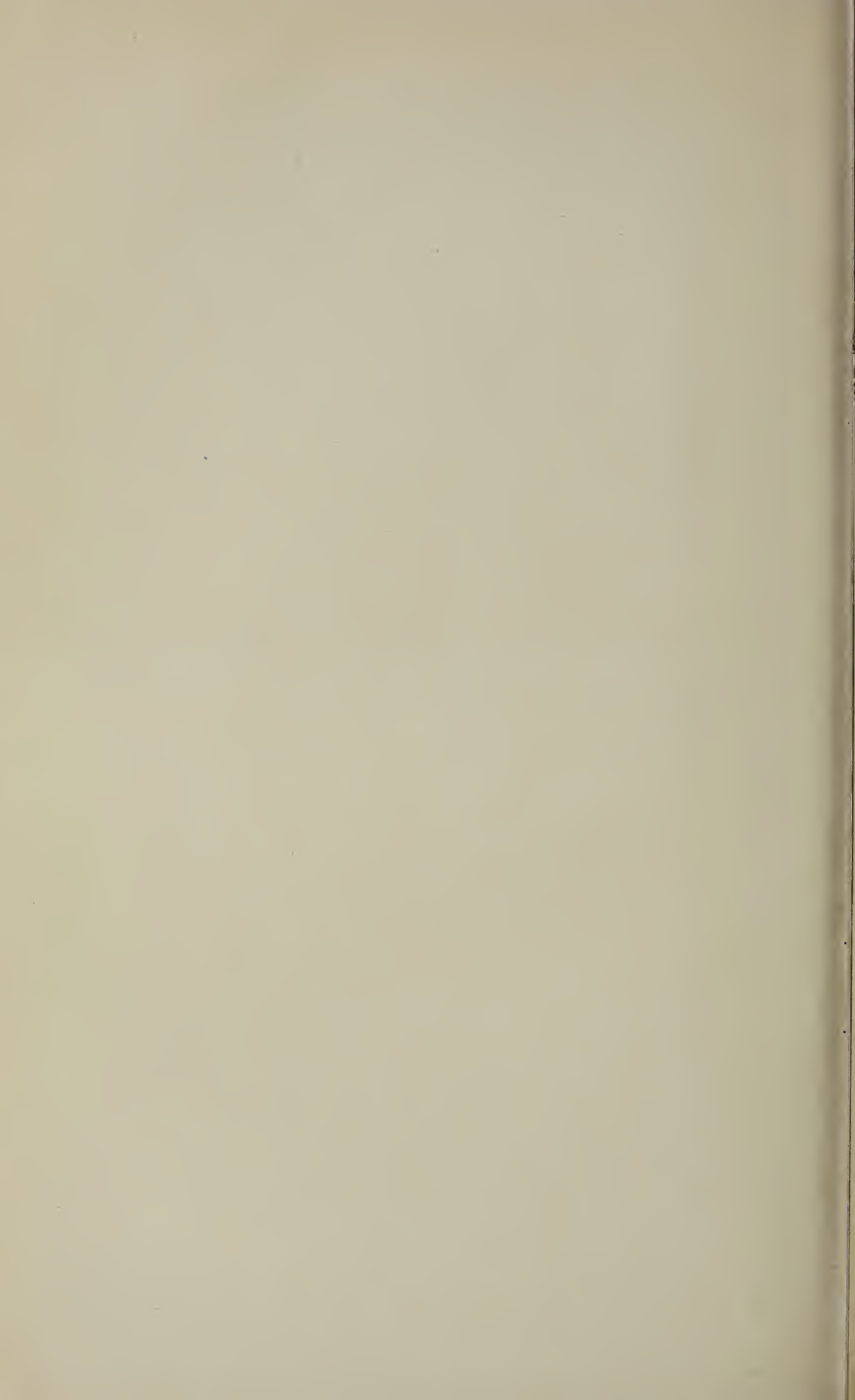
CULTIVATING SUGAR BEETS. AMES, NEBR.







HARVESTING SUGAR BEETS, SAGINAW, MICH.





the beets out of the wagon with beet forks or shovels. (Pl. X.) Sometimes special dumps are arranged at the factory whereby whole wagon loads of beets are precipitated at once into the bins. Such dumps are expensive to the factories, and not very many have them put in. One of the best arranged devices for dumping that I have examined is that in use at Fremont, Ohio. Long beet bins are built near to and parallel with each other. Wagons drive in over bin No. 1, and the beets are dumped out of the wagons into the bin. The driveway is constructed over the bins composed of a series of platforms upon which the wagons are driven. Each platform will hold a wagon, and has machinery for dumping the beets. When one bin is full, all these platforms, by means of travelers and a windlass, are moved over to the second bin, which is filled in like manner. This process is repeated until all the bins are filled. One set of platforms and dumps do the work for all the bins.

The farmer usually aims to haul from 2 to 3 tons of beets at a load. This amount depends upon the kind and condition of the road leading to the factory. In many cases special wagon boxes are used for hauling beets. It is found impracticable to haul beets by wagon farther than 7 to 10 miles. If grown farther than this from the factory, they are usually hauled to the cars and delivered to the factory by the carload.

I noticed last year that in several places a new idea in the delivery of beets had been introduced. Special dumps were made at points in the country over side tracks along the railroad. (Pl. XI, fig. 2.) These dumps are fitted with scales for weighing, and arrangements are made for taking samples. Farmers haul their beets to the nearest dump. A long approach is built and up this the farmer drives his wagon, which is then fastened to the platform, and the whole is tilted backwards, precipitating the beets into the car. The whole operation requires about three minutes' time, so that a large number of beet haulers can be accommodated in a short time.

#### SAMPLES AND TARE.

Whenever a wagonload of beets is delivered to the factory, a basketful, promiscuously selected, is taken out as a sample. This sample is tagged and on the tag is noted the weight of the load of beets. It is then sent to the chemical department of the factory, where it is analyzed for sugar content and purity, thoroughly washed to remove all the adhering dirt or tare, and reweighed. The per cent of tare is thus determined for the particular load from which the sample was taken. The factory may do this with every load or determine the tare by testing only part of the loads.

The question of tare is the cause of constant friction between the farmers and the factory managers. Some kinds of soil adhere more

than others; therefore, some farmers have more tare than others. The same soil sometimes adheres more than at other times, and the farmer gets different rates of tare, so that the tare is constantly a matter of dispute.

#### SUGAR CONTENT AND PURITY.

The samples used in determining the tare are also used by the chemist in determining the quality of the beets. This information is to complete the records of the factory, in order to compute the extraction of available sugar. Often factories buy beets on a sliding scale, paying so much per ton for beets of certain quality and more for beets higher in sugar content and purity, so that the work of the chemist is important.

#### SILAGING.

While beets should be harvested as soon as they are ripe to avoid the deteriorating effects of frost or rain, yet not all beets can be delivered to the factory at the same time. The beet sheds have not sufficient capacity. Many companies require that a certain portion of the beets shall be siloed in the fields where they are grown. This is accomplished by placing them in single piles containing a good load, or in long ricks. Plows are run up and down alongside of these ricks or piles, and the soft dirt is thrown over the beets to the depth of several inches. Then, hay, straw, and beet leaves are thrown on top of that. Holes are left for ventilation. Beets can be kept for some time in this manner.

#### FROZEN BEETS.

Throughout New York, Ohio, Michigan, and Minnesota, during the past year, heavy freezing weather occurred before the campaign was half over. Many of the beets grown for factories in these States were frozen solid. I wrote to the factories to get the results of their experience with frozen beets, and found that in no instance did this freezing produce any particularly bad effect. The temperature fell to 20 below zero before the 20th of December, and was as low as that several times before the campaign closed.

#### NEWS ITEMS AND PRESS COMMENTS.

Under this heading are compiled facts of interest regarding the beet-sugar industry taken from my own notes, and clippings from local papers, especially papers representing the beet-sugar interests. This information is arranged according to States and towns or localities.

#### CALIFORNIA.

OXNARD.—The following is taken from a recent issue of the Sugar Beet Gazette:

The Patterson Ranch Company's balance sheet shows some very interesting and instructive figures on its last year's business. It is a carefully conducted property,

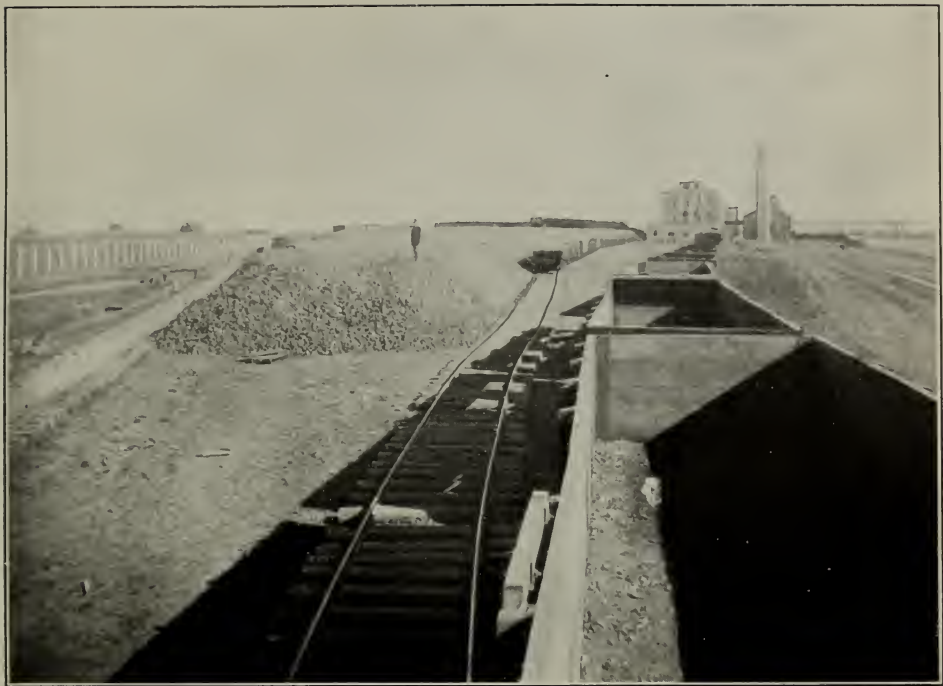


FIG. 1.—PILE OF BEETS BY RAILROAD; FACTORY AT LOVELAND, COLO.



FIG. 2.—UNLOADING BEETS INTO BEET SHEDS. SUGAR CITY, COLO.



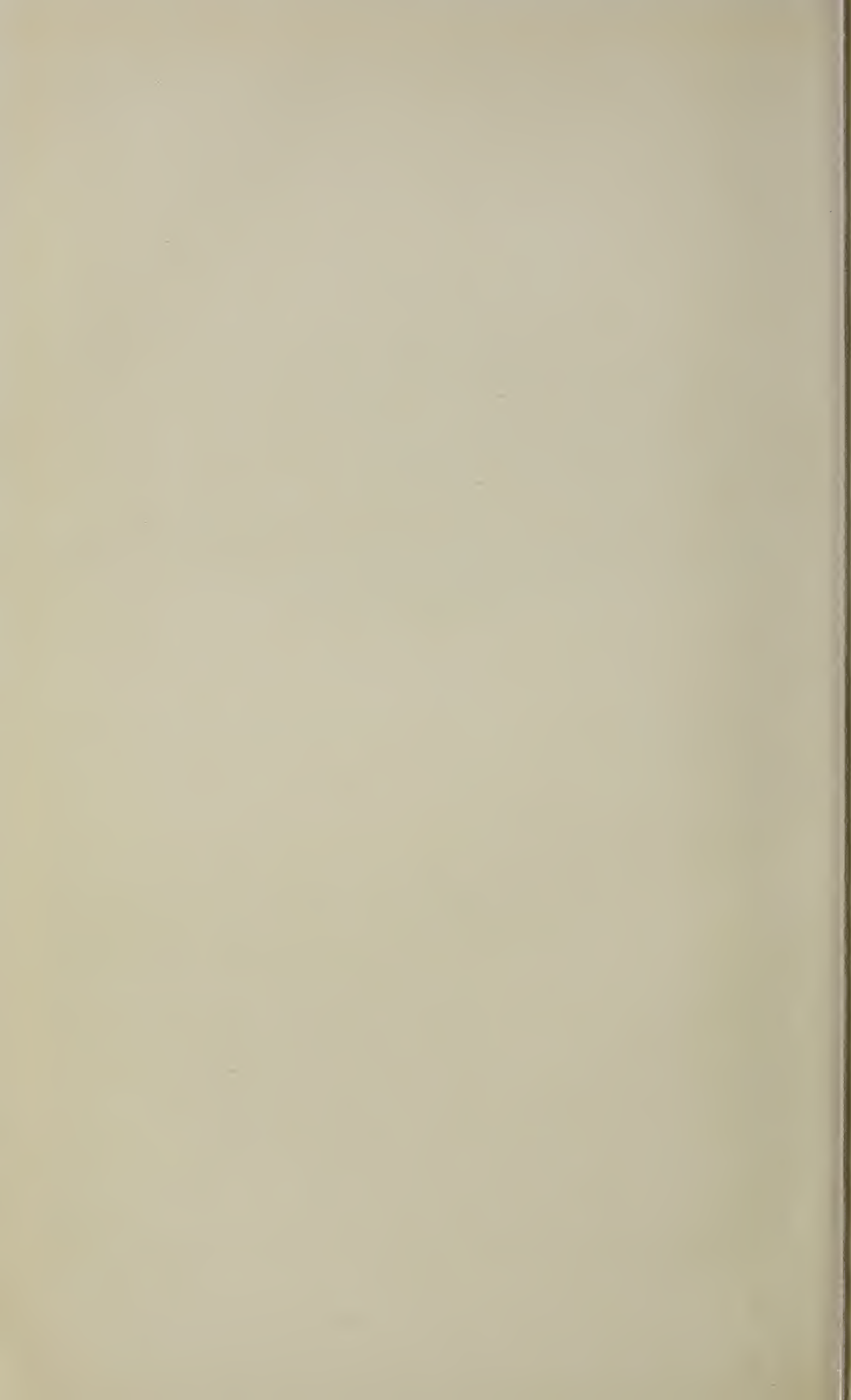




FIG. 1.—WEIGHING BEETS, SAN RAMON VALLEY, CALIFORNIA.



FIG. 2.—BEET DUMP, DANVILLE, CAL.





and an account is kept of acreage, expenses, etc., on every crop raised. While last year was not the most favorable, and the cost of irrigation had to be added to the ordinary expenses of farming, the best crop raised on the ranch was very satisfactory. The company's balance sheet shows gross receipts from beets were \$86,120.90, and the average net profit per ton of beets was \$2.35, including pasture of beet tops. We give some of the figures:

Acres harvested .....	1, 458
Beets delivered..... tons..	18, 438
Gross receipts.....	\$86, 120. 90
Sugar content..... per cent..	17. 6
Purity..... coefficient..	79. 6
Tare .....	2. 78
Price received per ton.....	\$4. 67
Average cost of raising per ton.....	2. 37
Average profit per ton .....	2. 29
Average profit per ton, including beet-top pasturing.....	2. 35
Average cost per acre to farm.....	29. 97
Net profit per acre .....	29. 78
Total net profit.....	43, 329. 39

This demonstrates, under the least favorable conditions as to season, that beet raising on a large scale is one of the most profitable branches of farming possible in this valley. There are many other instances that would make an equally favorable showing, but there are few ranches as well managed as the Patterson, or where a detailed account is kept of every expense connected with every crop. That fact gives added value to the results in this case.

Intelligent farming and certainty of prices make beets, even in years called bad years, one of the safest and most profitable crops the farmer can raise.

The ranch company was so well pleased with last year's results that it has contracted with the American Beet Sugar Company to plant 1,500 acres in beets this season.

#### COLORADO.

The following is clipped from the Rocky Mountain News, of Denver, Colo.:

The great value of sugar-beet factories to Colorado can not be estimated by the paltry dollars which the invested capital in the buildings and machinery add to the taxable assets of the State. Compared to other interests directly arising from the location of a sugar plant in any community, these assets are not the most important features. As a safe criterion, we can refer to Otero County, which has welcomed two factories in the past year, at a probable cost of \$2,000,000, which has been listed upon the country tax list. But let us look further. These two refineries have brought to the county at least four thousand new people, who have been enrolled as bona fide residents. The farming and agricultural lands have been enhanced in value at least \$3,000,000. The business and commercial interests of the county have been quickened by the increased capital which has been placed in circulation. The slipshod custom of careless agricultural methods has been abandoned, and the theory of intense farming has been almost universally resorted to.

The value of an acre of land depends on the amount of cash it will pay its owner each year, and its value can not legitimately rise above this basis. Here is where the great profit in general comes in from the establishment of the factory and the growing of sugar beets. Land which has heretofore produced, when cultivated in ordinary farm crops of alfalfa and grain, from \$7 to \$10 per acre net to the owner is capable of producing, when properly planted to sugar beets, from \$50 to \$70 per acre,

besides giving permanent employment to at least four times the number of laborers. Hence, we can see in the starting of every factory the solution of two great problems—the increase of land values and the maintenance of a fourfold greater population.

LOVELAND.—A. V. Officer, manager of the Loveland beet-sugar factory, has interested clergymen and charitable persons in the cities, who are sending him boys to work in the beet fields. The ministers find it a good way to make boys self-sustaining and bring them up to habits of industry, while the beet growers find the boys are excellent workers in the fields.

When the Great Western Construction Company began operations, 30,000 tons of beets lay in the sheds ready to be sliced.

PUEBLO.—The Nuckalls Packing Company, of Pueblo, will erect yards and pens for several hundred head of cattle at Sugar City, to be fattened on the beet pulp from the National Sugar Company's plant.

ROCKY FORD.—Experiments have been conducted at Rocky Ford to determine the value of beet pulp as food for cattle and sheep, and the results have proven highly satisfactory. It has been demonstrated that pulp is a superior food for stock, taking the place of corn at one-third less expense. Many inquiries have been made as to the consistency of the pulp. Many have an idea that it will be mushy. That is the case unless the pulp is pressed dry. I understand the Loveland factory will install machinery for pressing the pulp comparatively dry, which will greatly add to its usefulness for feeding during freezing weather.

Beet pulp from the sugar factory at Rocky Ford has proven so valuable as a food for cattle that the dairy interests are experiencing a boom in that town. A number of herds of milch cattle are being brought to the place, and the production of milk will be greatly increased.

SUGAR CITY.—The following is clipped from a local paper published in the vicinity:

The large amount of land acquired by the National Sugar Company at Sugar City for growing sugar beets will necessitate an addition to the population of that place of 500 laborers in seeding time. In less than one year Sugar City has grown from nothing to a city of 2,000 inhabitants. Laborers from Denver and other places are arranging to go to Sugar City.

#### ILLINOIS.

The Illinois State board of agriculture offered premiums in 1901 to beet growers as follows:

For largest yield of beets grown on 1 acre of ground: First premium, \$50; second premium, \$25; third premium, \$15; fourth premium, \$10.

For exhibit of 15 beets, weighing not less than 1 pound each, showing the highest test of sugar: First premium, \$20; second premium, \$15; third premium, \$10; fourth premium, \$5.

For exhibit of 15 beets, weighing not less than 1 pound each, showing the highest test of sugar and grown by boy 16 years of age or under: First premium, \$20; second premium, \$15; third premium, \$10; fourth premium, \$5.

For the best kept account and record showing the cost and labor performed in growing 1 acre or more of beets: First premium, \$20; second premium, \$15; third premium, \$10; fourth premium, \$5.

For paper on "Growing sugar beets for profit," containing about 1,500 words: First premium, \$20; second premium, \$15; third premium, \$10; fourth premium, \$5.

**BLOOMINGTON.**—The following report appeared in the columns of the Sugar Beet Gazette:

The following detailed report of the actual cost of the labor in raising 378 acres of sugar beets in this vicinity is furnished by Mr. A. G. Kingman, superintendent at this place for the Illinois Sugar Refining Company at Pekin. The report is very interesting for comparison with previous estimates of such cost, and because it is the average of a large number of acres. The estimate given below for the corresponding items of labor is that of Prof. P. G. Holden:

*Cost of raising and harvesting a sugar-beet crop.*

Items of work done.	Actual cost.	Estimated cost.
Clearing stalks.....	\$0.53	\$1.00
Plowing.....	1.23	.50
Preparing ground.....	1.17	1.15
Seeding.....	.27	.35
Bunching.....	2.06	1.50
Thinning.....	3.28	3.50
Weeding and hoeing.....	9.14	5.00
Cultivating.....	.50	2.00
Lifting.....	1.35	1.00
Pulling and topping.....	5.50	5.00
Hauling.....	4.68	5.00
Total.....	29.71	28.00
Total team work.....	9.73	13.00
Total hand work.....	19.98	15.00

It will be seen by the above that the actual cost in the aggregate was very close to the estimate. The widest difference was in the item of weeding and hoeing, which cost \$9.14, while the estimate was only \$5. There were special reasons for this extra cost, which could scarcely occur two seasons in succession. A wet spell, preventing work, allowed the weeds to get quite a start, and then the Bloomington fire and a circus attracted the workers from the fields until the condition required much extra hand work. The cultivators could not be used as usual at this time, and it will be seen that the cost of cultivating was only 50 cents per acre, while the estimates allowed \$2.

The comparison given is on items of labor only and does not include rent of land, seed, superintendence, interest or investments, rents, and repair of tools, freight, etc. These items in the estimate are placed at \$12.50.

The total cost for the hand work was \$7,552.44, and for team work \$3,677.94.

Lifting.....	\$540.30
Hauling.....	1,591.58
Pulling, piling, and topping.....	2,305.39
Sundries.....	13.78
Superintending.....	374.00
Total.....	4,825.05



## IOWA.

CERRO GORDO COUNTY.—There were nearly 200 acres of beets raised last year, and most of the product was shipped to the Minnesota Sugar Company of St. Louis Park. The farmers were beginners in beet growing, and under the circumstances did very well. The average yield was 12 tons to the acre and the best 20. The beets averaged 13.12 per cent sugar content and 84.30 purity. The people of Clear Lake, in that county, are trying to secure a sugar factory.

FORT DODGE.—The Sugar Beet Gazette says:

About a year ago the Fort Dodge Beet Sugar Company began its efforts to develop the sugar-beet industry in Webster County. Mr. Chantland, the secretary, furnishes the following figures of sums they are paying out as the result of the first year's work. These prices are net, after deducting the price of seed and rent of machinery:

Andre Chantland, Badger, 5 acres, \$373.25, or \$74.81 per acre.  
 Adolph Houge, Badger, 5 acres, \$224.85, or \$44.96 per acre.  
 J. H. Alpers, Fort Dodge, 2 acres, \$116.93, or \$58.46 per acre.  
 P. J. Shultz, Clare, 2½ acres, \$120.10, or \$48.04 per acre.  
 J. J. Rutledge, Douglas Township, 3 acres, \$98.04, or \$32.68 per acre.  
 C. L. Blaine, Douglas, 2 acres, \$85.72, or \$42.86 per acre.  
 Louis Elbert, Cooper, 2 acres, \$76.60, or \$38.30 per acre.  
 Ole Levold, Badger, 1 acre, \$45.46.  
 O. E. Edwards, Clare, 2 acres, \$81.16, or \$40.58 per acre.  
 T. W. Thomas, Cooper, 4 acres, \$33.10.  
 J. H. Fialo, Fulton, 3 acres, \$110.76, or \$36.92 per acre.  
 Frank Fiderlick, Elkhorn, one-half acre, \$21.70.

SIoux CITY.—The following is clipped from the same journal:

The plant of the Sioux City Beet Sirup and Preserving Company is in operation, as far as the machinery that has been installed up to date will permit. More machinery is expected, and the plant will probably be in full blast by January 1, 1902. It is now turning out all kinds of sirups and rock candy, besides jellies, jams, apple butter, and some mince-meat.

Negotiations have been completed for the establishment of the plant of the Omaha Beet Sirup and Chicory Company, at South Sioux City. The Omaha people take \$80,000 of the \$100,000 capital stock. The company will be incorporated under the title of South Sioux City Beet Sirup and Chicory Company.

The beet sirup manufactured by the Omaha Beet Sirup Company received the highest award at the Pan-American Exposition at Buffalo, the prize being a gold medal for its excellence. This award was received in competition with other sirups, such as cane, maple, and sorghum sirups from all parts of the country. The officers of the company, including Manager Peterson, are proud of the showing made by the product of the Omaha factory.

## IDAHO.

The State of Idaho passed a beet-sugar bounty law, which was signed by the governor.

## MICHIGAN.

The following on "Sugar-beet examination in Michigan" was written by P. F. Trowbridge, of the University of Michigan:

At the different beet-sugar factories in Michigan two methods are used for finding the amount of tare (dirt adhering to the beets).

*First method.*—A half bushel of beets is taken from each wagon or car as a sample, satisfactory to both the farmer and the factory representative. From this sample 20 to 25 pounds are carefully weighed. These beets are then well brushed with bristle brushes, and retopped if the whole of the crown has not been removed. The beets are again weighed, and the loss in weight computed to per cent is reported as the amount of tare.

*Second method.*—The weighed sample is washed in a revolving washer, allowed to drain for a few moments, retopped if necessary, and again weighed. The loss in weight is reported in terms of percentage. The second method requires less labor, and is more rapid. It is also more nearly in accord with the factory operation. The first method fails to remove every particle of dirt, but does remove many small root-lets and a small amount of the outside of the beets, especially if they have been frozen.

In the second method the adherent water tends to decrease the amount of tare. In the following series of experiments, made at one of the Michigan factories, care was exercised to make both samples from each load as representative as possible.

*Methods of determining the tare compared.*

Number of sample.	Tare by first method.	Tare by second method.	Difference.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
1.....	8.75	6.25	2.50
2.....	10.00	8.75	1.25
3.....	13.75	13.75	0.00
4.....	7.50	7.50	0.00
5.....	5.00	6.25	1.25
6.....	21.25	22.50	1.25
7.....	8.75	6.25	2.50
8.....	10.00	7.50	2.50
9.....	11.25	11.25	0.00
Average.....	10.14	10.00	.14

The following comments concerning developments at various points in Michigan are taken from issues of the Sugar Beet Gazette:

**BAY CITY.**—It has been decided to erect a plant at Bay City for the purpose of utilizing the molasses from a number of sugar factories. The Saginaw Sugar Company is interested in the enterprise. Just what is to be produced from the molasses has not been learned. Carman N. Smith, of Minneapolis, is promoting the deal.

The Michigan Chemical Works, which is to use the residue molasses from the sugar factories, will begin operations in a few days. The company has forty tank cars of 7,000 gallons capacity each, which will bring the molasses from the various factories. From the molasses alcohol and potash will be made.

**CARROLLTON.**—The Valley Sugar Company have begun work on their sugar plant and are building what they claim to be the most extensive beet sheds in the world, which are to have a capacity of 15,000 tons.

**LANSING.**—Since the beet-sugar factory at Lansing has become an assured fact a large number of neighboring farmers are plowing up their wheat, which is said to be in bad condition, and are planting the ground to sugar beets.

A consignment of 4,200 sheep have reached Lansing, which will be fattened on the beet pulp turned out by the Lansing Sugar Company. The sheep are the property of W. H. Gilbert, of Bay City, and L. S. Boutell, of Lansing. Pens have been prepared at the sugar factory, and about 300 will be placed in each pen. Students from the agricultural college will have charge of each pen, to assist in feeding, weighing, and otherwise caring for the sheep, and the work will be done in a systematic man-

ner, all the details and results being carefully noted, so that an accurate record may be had in the spring of the development of these lambs. Silos have been erected at the Lansing factory at a cost of \$4,000, and all the conditions for a successful experiment have been carefully arranged so that the results in the spring should prove of value in determining the efficiency of sugar-beet pulp as a feed.

The farmers are beginning to appreciate the value of pulp for feeding purposes. They are eagerly taking it from the factory, and a number of cattle feeders in the vicinity are hauling away large quantities, having found its effects on their stock most beneficial.

SAGINAW.—The farmers are now drawing considerable sugar-beet pulp from the Saginaw Sugar Company's factory and will use it for feeding stock. Those who have experimented with the product pronounce it excellent for fattening purposes, and it is now believed that it will be used extensively by growers who are raising stock for market.

#### MONTANA.

Governor Toole, of Montana, vetoed the bill which proposed a bounty of one cent a pound on beet sugar produced in the State, and limiting the bounty to \$40,000.

HAMILTON.—B. McGinty, superintendent of the Daly Bitter Root farm, of Hamilton, in an interview in the *Anaconda Standard*, said:

At present the experiment of raising sugar beets is being conducted, and if the tests are satisfactory and the land found suitable, it may be that the farm will be converted into a big sugar-beet plantation, and a refinery built to work the crop into the finished product. The experiments going on are rather expensive, but I don't suppose they are anything to what will be done should the growing of sugar beets prove successful. At present there are fifteen different patches of beets, which are being cared for by an expert in that line. Every patch is composed of a different soil, and in this way the best results will be obtained. From what I have heard, and from my own personal observation, the beets are doing fine, and there is no reason why that section of the country should not become an important factor in the beet-sugar industry. One peculiarity in the experiments is the evident good results obtained from all the various soils.

#### NEW YORK.

BINGHAMTON.—The capacity of the factory of the Binghamton Beet Sugar Company is being increased to 600 tons. Work is well along and beet slicing is expected to begin early in October.

ROME.—The factory at this place has reached the end of its career, as is shown in the following item from the *Sugar Beet Gazette*:

The real property of the first New York beet-sugar factory at Rome was sold at receiver's sale January 17. The purchasers were F. B. Smith and S. M. Stevens, representing the bondholders. The figure accepted was \$18,000.

The machinery, boilers, and fixtures were sold for the bondholders to Hans Brumn, of Kiehl, Germany, who intends to ship them to North Dakota and utilize them in fitting out a dextrin factory.

#### OHIO.

FREMONT.—The Continental Sugar Company, in addition to a larger crop of its own than last year, purchased the beets which were grown for the Illinois Sugar Refining Company, at Pekin, Ill. The factory



has erected additional beet sheds, and has now ample accommodations for all the beets that may be received.

## UTAH.

LEHI.—At a recent meeting of the directors of the Utah Sugar Company it was decided to increase the capital stock of the corporation from \$1,000,000 to \$2,000,000.

One-half of the money to be raised from the new issue, \$500,000, will be used immediately in paying for the Bear River Canal and the 30,000 acres of land under it recently purchased for the sugar company by Manager T. R. Cutler. The rest will be retained in the treasury, it being the intention to erect, at some future time, a new factory in the Bear River Canal country, possibly near Corinne.

## WASHINGTON.

WAVERLY.—Beet pulp from the sugar factory at Waverly is being successfully used to fatten 300 beef cattle on the stock farm of W. E. Mann, near that town. Mr. Mann says:

I am feeding 300 head of 3 and 4-year-olds most successfully on the pulp. The cattle consume on an average nearly 100 pounds each per day, in addition to hay. The animals are putting on flesh in fine shape—better than 3 pounds a day.

The pulp from the beet-sugar factory is excellent feed. It can be kept in an ordinary silo, and is good feed for a year, and with care can be kept two years.

I secured the stock I am now fattening from Okanogan County. I expect to begin selling in about thirty days, when the animals will be in prime condition. This is the first season I have experimented with beet pulp as fodder. So far there is every indication of success.

The beet pulp from the sugar factory is sufficient to fatten annually 1,000 head of cattle. I have now ready 250 head of fat steers which have been fed on the pulp. The experiment has been most satisfactory. I find it necessary to use straw and hay in small quantities with the pulp, and a little grain is good to top off with at the end of the feeding season. I anticipate there will be many cattle fattened next fall and winter on the beet-sugar pulp.

## WISCONSIN.

BEAVER DAM.—Quoting again from the Sugar Beet Gazette:

Many growers who contracted for only 2 acres say they will cultivate 10 next season. Messrs. A. E. Barker and C. C. Groose, who went to Michigan as delegates for the farmers here to look over the fields in that State, are enthusiastic about beet culture. These gentlemen have each contracted for 20 acres this year, but they will increase their acreage to 40 next season.

Most the bunching and thinning was done at a cost of \$7 to \$8 per acre, and strict attention to instructions was paid by the workers.

## IN GENERAL.

The following items of general information are clipped from recent issues of the Sugar Beet Gazette:

Sugar syndicates which manipulate the European market predict that the United States will produce all the sugar it needs, according to United States Consul

Donzelmann, at Prague, in a communication to the Department of State. It is shown that Russia, Germany, France, and England materially increased their consumption of sugar last year, while Spain, Italy, and the Balkan States have produced not only all the sugar needed at home, but are exporting to a small extent. Even Egypt, which recently was obliged to import about 50,000 tons annually from Austria, now exports large quantities to the United States and India. With reference to beet sugar the consul says that it is a surprising fact that the United States, with millions of acres of virgin soil and improved machinery, has such a comparatively small acreage planted in sugar beets and so few sugar factories.

The American Beet Sugar Company reports for the year ended December 31 last:

Sugar produced.....	pounds..	33, 351, 500
Total credit.....		\$1, 931, 707
Total cost of operating.....		1, 166, 240
Freight on sugar.....		97, 301
Total.....		1, 263, 541
Total profit from operation.....		668, 166
Total cost of maintenance.....		242, 530
Balance.....		425, 636

Among the principal items of the balance sheet of December 31 are: Treasury stock, \$1,000,000; cash on hand, \$97,458; estimated value of sugars on hand, \$229,000. The estimated surplus account for the fiscal year ending June 30, 1901, shows: Total credits of campaign \$511,363, loss \$85,728; net factory profits of campaign, \$425,635, less general expense and interest, \$130,000; balance, \$295,635, less preferred dividends, \$240,000; net profits, \$55,635.

A résumé of the output of beet and cane sugars in European countries may be made as follows:

*Output of beet and cane sugars in Europe.*

Country.	1898-99.	1899-1900.	1900-1901.
Beet sugar:	<i>Tons.</i>	<i>Tons.</i>	<i>Tons.</i>
Austria.....	1, 042, 000	1, 099, 000	1, 070, 000
Germany.....	1, 720, 000	1, 791, 000	1, 900, 000
France.....	782, 000	919, 000	1, 070, 000
Russia.....	755, 000	898, 000	900, 000
Belgium.....	209, 000	270, 000	320, 000
Holland.....	150, 000	170, 000	170, 000
Denmark.....	40, 000	41, 000	50, 000
Sweden.....	60, 000	81, 000	110, 000
Roumania, Italy, and Spain.....	40, 000	110, 000	160, 000
Total.....	4, 798, 000	5, 879, 000	5, 750, 000
Cane sugar.....	2, 654, 000	2, 442, 000	2, 907, 000
Grand total.....	7, 452, 000	7, 821, 000	8, 657, 000

The results that will be obtained from beets containing 12 per cent sugar under varying purities in the same factory and by the same process of manufacture are shown in the following table:

*Variance in proportions of molasses and sugar.*

Sugar in beet.	Purity co- efficient.	Molasses.	Sugar.
<i>Per cent.</i>		<i>Per cent.</i>	<i>Per cent.</i>
12	70	5.12	6
12	72.5	4.45	6.67
12	75	3.82	7.29
12	77.5	3.25	7.87
12	80	2.70	8.42
12	82.5	2.19	8.93
12	85	1.70	9.42
12	87.5	1.24	9.88
12	90	.80	10.32

FORMS OF CONTRACTS.

Below I give the forms of two contracts, one made by a sugar company with the farmers growing beets, and the other by a sugar company with laborers hired by it to grow beets on its own land.

These contracts are given as typical of such agreements where sugar-beet factories are established. The first shows the requirements of the factories, the scale of prices paid for beets, etc. The second gives an idea of the work performed by the laborer, and what he receives per acre for such work. He is supposed to perform all the labor necessary in growing a crop of beets, except that which must be performed with a team in plowing, cultivating, and delivering the beets to the factory.

CONTRACT BETWEEN SUGAR COMPANY AND FARMER.

This agreement made and entered into this — day of —, 190—, between — (a corporation), the first party, and —, of —, second party, witnesseth:

That the first party agrees to purchase from second party any and all beets he may grow from seed that may be sown by the first party on the — acres of land hereby agreed upon, that do not weigh over three and one-half pounds each, to be delivered by the said second party as required by first party at the following prices and on the following conditions and not otherwise, to wit: For any and all beets that may be ordered by the first party from second party during the months of September and October, 1900, the said first party will pay the said second party on the 15th of each month for all beets that have been delivered during the preceding month the sum of \$4.50 per ton.

The first party further agrees that during said months of September and October it will take at said price from said second party any and all beets grown upon said land that have an average polarization of not less than 14 per cent saccharine and 80 per cent purity, provided said beets are delivered in a proper manner under first party's direction, in the sheds of the said first party, at —, or on cars at —, at option of first party, at cost of second party, in first-class condition, with the tops closely and squarely cut off at the base of the last or bottom leaf. The beets so delivered shall reach all the requirements of this agreement, and not contain any diseased, frozen, damaged, or improperly topped beets, nor any beet that weighs over three and one-half pounds, otherwise the entire load so being delivered may be rejected. The dirt weighed with the beets shall be tared and deducted from the gross weight by the first party in its customary manner and shall be conclusive. In



case any part of said beets are not ordered, or if any part of patch has been stopped because of the polarization not holding up to the standard as per this agreement before the first day of November, A. D. 1900, then first party agrees with second party that it will purchase any and all beets not so ordered or delivered on and after said first day of November, 1900, and until and including the 30th day of November, 1900, that may be raised on the said land as aforesaid that polarize not less than 12 per cent saccharine with 80 per cent purity, and no others, at the following average polarizations and following prices per ton, to wit:

Saccharine.	Purity.	Price.
<i>Per cent.</i>	<i>Per cent.</i>	
14	80	\$4.50
13	80	4.25
12	80	4.00

For all beets delivered, payments to be made on the 15th day of the succeeding month thereafter. After the 30th of November, 1900, it shall be optional with the first party whether or not it accepts any beets that have not been delivered. The second party hereby agrees to prepare said land in first-class condition for the planting of said beet seed, cultivate and harvest in a husbandlike manner — acres of sugar beets on the land agreed upon, and protect them from the frost and sun while being harvested and delivered, and to deliver them at the times and places, and in the manner set forth in this contract for the prices above named, to be paid as above set forth; and further agrees to pay the first party the sum of \$2.75 per acre for the furnishing of the seed and planting the said land, which may be done by the first party as fast as circumstances will permit.

To ascertain the quality of said beets the first party shall, at various times during the growing and harvesting season of 1900, also at times of delivery, sample and polarize in its usual manner.

During the month of November, 1900, not less than ten average beets per acre shall be taken by the first party to ascertain the value of all beets that have not been ordered, and shall be conclusive. During the month of November the second party may deliver beets as fast as they may desire if the said beets reach the requirements of the contract.

This contract is personal and not transferable.

\_\_\_\_\_,  
\_\_\_\_\_.  
\_\_\_\_\_.

#### CONTRACT BETWEEN THE SUGAR COMPANY AND THE FARM LABORER.

This agreement, made and entered into, in duplicate, this — day of —, A. D., 190—, by and between — Beet Sugar Company, party of the first part, and — party of the second part,

Witnesseth, That for and in consideration of the promises and agreements herein-after set forth, said first party has hired and employed said second party, and said second party has agreed and does hereby agree to bunch, thin, hoe, keep free from weeds and in a first-class condition, satisfactory to said first party or to its agent, until such time as the crop shall be ready for laying by, and then when directed to harvest said crop, then to pull, top, and pile together, all to be done as instructed, — acres of sugar beets near —, County of — and State of —, and being on section —, township —, range —.

In consideration of faithful performance by said second party, as hereinbefore set forth, said first party has agreed to and will pay to said second party, from time to time as earned, the several sums following:

\$6 per acre after the bunching and thinning of beets.

\$4 per acre when the entire summer's work is done.

\$2 per acre when the harvesting is commenced.

\$6 per acre when the balance of the work has been done and the harvest is completed, which time will be not earlier than November — next.

For each ton of beets above an average of ten tons per acre raised by party of the second part under this contract, the party of the first part agrees to pay to party of the second part the sum of 50 cents per ton as a bonus over and above the contract price per acre.

It has been further expressly agreed that in case said second party fails in any way to do and perform as he has agreed to do, that then and in such case said second party hereby expressly consents that said first party may hire such work to be done as may be necessary to do as said second party has undertaken to do, and as against this contract charge up said charges, the difference, if any, accruing to said second party to be paid to him, or in case of any deficiency he agrees to pay the same to said first party on demand, and during the term of this contract he expressly grants to said first party and its employees the right to the full and entire possession of the premises where said sugar beets are grown.

In presence of:

#### PRICES PAID AT DIFFERENT FACTORIES.

The following sections are taken from different printed contracts between the companies and the farmers and indicate the various prices paid for beets by the different companies:

All sound beets to be bought and paid for by said factory at the following rates, viz:

All beets containing fourteen (14) per cent of sugar or less, four (\$4) dollars per ton, and an additional twenty-five (25) cents per ton for each and every one (1) per cent of sugar above fourteen (14) per cent, fractions in proportion.

An additional sum of twenty (20) cents per ton will be paid for each and every ton of beets siloed, when delivered at the factory, after November 15th.

Beets to have the tops squarely cut off so as to remove the entire portion on which leaves have grown, and to be subject to the usual tare for dirt and improper topping.

For beets containing 12 per cent of sugar and under 13 per cent to the weight of the beets, \$4.25 per ton of 2,000 pounds; 13 per cent and under 14 per cent, \$4.58½; 14 per cent and under 15 per cent, \$4.91½; 15 per cent and under 16 per cent, \$5.25, and 33½ cents per ton for each additional full 1 per cent of sugar content. All beets to have a coefficient of purity of 80 or more.

For any and all beets furnished and delivered in accordance with the provisions of this contract the first party agrees to pay the sum of \$4.50 per ton, such payment to be made on or about the 15th day of each month for all beets delivered during the previous month.

And the said party of the first part agrees to pay to the party of the second part for all beets delivered at its factory as follows:

For beets containing 12 per cent of sugar to the weight of the beet, and under 16 per cent, \$4 per ton of 2,000 pounds; for beets containing 16 per cent of sugar to the weight of the beet, and under 17 per cent, \$4.33½ per ton; for beets containing 17 per

cent of sugar to the weight of the beet, and under 18 per cent, \$4.66 $\frac{2}{3}$  per ton; for beets containing 18 per cent of sugar to the weight of the beet, and under 19 per cent, \$5 per ton; and 33 $\frac{1}{3}$  cents additional advance per ton for each and every per cent thereafter.

Should any of the beets contain less than 12 per cent of sugar to the weight of the beet, and 78 per cent purity, the price paid per ton will be \$3 for all such beets accepted at the factory; but the said first party reserves the right to accept at its factory only such beets as it may deem fit for manufacturing purposes.

For any and all beets furnished and delivered in accordance with the provisions of this contract, the first party agrees to pay the sum of four dollars and fifty cents (\$4.50) per ton, such payment to be made on or about the fifteenth day of each month for all beets delivered the previous month.

Said first party shall pay said second party the sum of \$4 per ton for the same; provided, however, said beets shall contain not less than 12 per cent nor more than 14 per cent sugar to the weight of beet, with a purity coefficient of 80.

#### FEEDING SUGAR-BEET PULP IN EUROPE.

I inclose a copy of the report made by United States Consul Baehr, at Magdeburg, Germany, on the "Rations for cattle and sheep with sugar-beet pulp."

Probably in no other country in the world has the feeding of beet pulp been studied and tested more extensively or scientifically than in Germany. This report will be very interesting at this time as giving the conclusions reached after years of experience.

The metric system is used throughout, weights being given in kilograms. After each item I have inserted in parenthesis the equivalent in pounds.

In the headlines introducing each of the various food rations, the consul gives the number of pounds of "dry matter" entering into the ration. This refers to the ration free from moisture. In the ration itself the weight given to each item refers to the food with its natural moisture.

#### RATIONS FOR CATTLE AND SHEEP WITH SUGAR-BEET PULP.

There is no difference between the results of feeding fresh pulp and that which has been stored in a silo. Both kinds have the same effect and are therefore used in equal quantities. The difference between them is that, according to the manner of storing, from 15 to 30 per cent of the substance is lost by the storing in the silos.

In the following tables moist pulp is referred to:

##### *I. Draft oxen with fair amount of work.*

Food requirements per 1,000 kilograms (2,200 pounds) live weight, per day 25 kilos (55 pounds) dry substance, containing about—

2.0 kilos (4.4 pounds) protein.

0.5 kilos (0.11 pounds) fat.

11.5 kilos (25.3 pounds) carbohydrates.



Ration recommended:	Kilos.	Equiva- lent in pounds.
Fresh pulp.....	60	132
Meadow hay.....	6	13.2
Summer straw.....	5	11
Winter straw.....	5	11
Malt sprouts.....	2	4.4
Cotton-seed cake.....	2.5	5.5
Ration for same with less work:		
Fresh pulp.....	40	88
Winter straw.....	8	17.6
Pulse chaff.....	12	26.4
Cotton-seed cake.....	1.5	3.3

*II. Dairy cows.*

Food requirements per 1,000 kilos (2,200 pounds) live weight, per day about 27 kilos (59.4 pounds) dry substance, containing—

2 kilos (4.4 pounds) protein.

0.4 kilos (8.8 pounds) fat.

11 kilos (24.2 pounds) carbohydrates.

Rations recommended to produce from 7.5 kilos (16.5 pounds) milk daily:

No. 1.—

	Kilos.	Equiva- lent in pounds.
Fresh pulp.....	30	66
Clover hay.....	5	11
Meadow hay.....	5	11
Oat straw.....	5	11
Wheat chaff.....	3	6.6
Malt sprouts.....	2	4.4
Oat bran.....	1	2.2
Palm-seed flour.....	2	4.4
Rice-seed flour.....	1.5	3.3
Meal flour.....	.5	1.1

No. 2.—

Fresh pulp.....	40	88
Lucern hay.....	5	11
Clover hay.....	3	6.6
Meadow hay.....	4	8.8
Winter straw.....	8	17.6
Rye bran.....	1	2.2
Coarse wheat bran.....	2	4.4
Cotton-seed cake.....	.5	1.1

No. 3.—

Fresh pulp.....	50	110
Clover hay.....	6	13.2
Meadow hay.....	5	11
Summer straw.....	4	8.8
Linseed cake.....	2	4.4
Sesame flour.....	1.5	3.3
Winter straw.....	3	6.6

Rations recommended to produce 10 kilos (22 pounds) of milk daily per 1,000 kilos (2,200 pounds) live weight per day, about 29 kilos (63.8 pounds) dry matter containing—

2.5 kilos (5.5 pounds) protein.

0.5 kilos (1.1 pounds) fat.

14.4 kilos (31.6 pounds) carbohydrates.

Rations recommended to produce 10 kilos (22 pounds), etc.—Cont'd.

No. 1.—	Kilos.	Equiva- lent in pounds.
Fresh pulp.....	35	77
Meadow hay.....	4	8.8
Clover hay.....	6	13.2
Oat straw.....	4	8.8
Wheat chaff.....	3	6.6
Moist beer grains.....	20	44
Malt sprouts.....	2	4.4
Rape-seed cakes.....	2.5	5.5
No. 2.—		
Fresh pulp.....	45	99
Clover hay.....	9	19.8
Summer straw.....	6	13.2
Winter straw.....	3	6.6
Wheat chaff.....	2	4.4
Peanut cake.....	2.5	5.5
Palm-seed cake.....	5	11

*III. Fatted cattle.*

Food requirements per 1,000 kilos (2,200 pounds) live weight per day, 30 kilos (66 pounds) dry matter containing—

3 kilos (6.6 pounds) protein.

0.7 kilos (1.54 pounds) fat.

14.5 kilos (31.9 pounds) carbohydrates.

Ration recommended:

	Kilos.	Equiva- lent in pounds.
Fresh pulp.....	50	110
Clover hay.....	6	13.2
Lucern hay.....	6	13.2
Barley straw.....	6	13.2
Moist beer grains.....	20	44
Bruised corn.....	3	6.6
Peanut cake.....	1	2.2

*IV. Fatted sheep.*

Food requirements per 1,000 kilos (2,200 pounds) live weight, per day, about 28 kilos (61.6 pounds) dry matter containing:

3.5 kilos (7.7 pounds) protein.

0.6 kilos (1.32 pounds) fat.

14.5 kilos (31.9 pounds) carbohydrates.

Rations recommended:

	Kilos.	Equiva- lent in pounds.
Fresh pulp.....	50	110
Lucern hay.....	12	26.4
Straw.....	8	17.6
Rye flour.....	5.5	12.1
Rape-seed cakes.....	4	8.8

V. *Growing cattle.*

Six to 8 months old, weighing about 250 kilos (550 pounds), daily fodder to contain about 6.3 kilos (13.86 pounds) dry substance with  
 0.63 kilos (1.386 pounds) protein.  
 0.2 kilos (4.4 pounds) fat.  
 3.4 kilos (7.48 pounds) carbohydrates.

Rations recommended:	Kilos.	Equiva- lent in pounds.
Fresh pulp.....	10	22
Meadow hay.....	4	8.8
Summer straw.....	2	4.4
Oats.....	1	2.2
Sesame cake.....	.5	1.1
Linseed.....	.13	.286

For same, age about 12 to 18 months, weight about 340 kilos (748 pounds), daily rations to contain per head about 8.2 kilos (18.04 pounds) dry substance with  
 0.7 kilos (1.54 pounds) protein.  
 0.2 kilos (0.44 pounds) fat.  
 4.2 kilos (9.24 pounds) carbohydrates.

Rations recommended:	Kilos.	Equiva- lent in pounds.
Fresh pulp.....	10	22
Meadow hay.....	4	8.8
Summer straw.....	3	6.6
Oats.....	1	2.2
Malt sprouts.....	.5	1.1
Palm-seed cake.....	.5	1.1
Sesame cake.....	.25	.55

VI. *Growing sheep; age, 8 to 11 months; weight, 46 kilos. (101.2 pounds).*

Food requirements per 100 sheep per day about 111 kilos. (244.2 pounds) dry substance, with—  
 14 kilos. (30.8 pounds) protein.  
 2.5 kilos. (5.5 pounds) fat.  
 66 kilos. (145.2 pounds) carbohydrates.

Rations recommended:	Kilos.	Equiva- lent in pounds.
Fresh pulp.....	100	200
Meadow hay.....	50	110
Pulse chaff.....	20	44
Oat chaff.....	10	22
Linseed.....	15	33
Rape-seed cake.....	15	33
Rye flour.....	10	22
Wheat flour.....	10	22



## CONTRIBUTIONS FROM THE BUREAU OF PLANT INDUSTRY.

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PREPARED UNDER THE DIRECTION OF B. T. GALLOWAY, CHIEF.

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### LETTER OF SUBMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF PLANT INDUSTRY,  
*Washington, D. C., March 27, 1902.*

SIR: I herewith submit for publication as part of the report on the beet-sugar industry a paper on "Some diseases of the sugar beet," by C. O. Townsend, and a paper on "Sugar-beet seed: Production and testing," by A. J. Pieters. Both papers were prepared under my direction, the writers being members of the force employed in this Bureau.

Respectfully,

B. T. GALLOWAY,  
*Chief of Bureau.*

HON. JAMES WILSON,  
*Secretary.*

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### SOME DISEASES OF THE SUGAR BEET.

By C. O. TOWNSEND, of the Bureau of Plant Industry.

#### INTRODUCTORY.

Owing to the rapid extension and development of the already important sugar-beet industry in the United States, and in view of the enormous losses that have been sustained by the sugar-beet growers during the past several years through the agency of plant diseases, the Office of Vegetable Physiology and Pathology has begun a special study of these diseases for the purpose of determining the most practical means by which the losses from this source may be avoided. In accordance with this plan, this work was taken up at the beginning of the present fiscal year and it is the object of the writer at this time to consider briefly the most important diseases of the sugar beet that have come to his attention during the past season, together with some of the problems that these diseases present to the practical grower, viz, the suppression or control of the fungous diseases and other

influences unfavorable to the production of sugar beets. Most beet growers in all sections of the country, even in those sections where the beets have been grown but a few seasons, realize that a proper understanding of the nature and treatment of the diseases of the sugar beet is necessary to the attainment of the best results in the production of this crop. While this is true, there are growers in nearly all sections who have not yet learned to distinguish, in all cases, between the normal and the abnormal beet.

There is no time in the life of the beet when it is not subject to attack from one or more forms of disease. The disease may be produced by unfavorable conditions of soil or climate, or by an attack of some parasite upon or in some part of the beet. It not infrequently happens that unfavorable conditions of weather and soil combine with parasitic attacks to produce disease. These fungous diseases may result in the entire destruction of the crop on the area affected, or the beets may continue to live but be greatly reduced in size or quality or both, causing a heavy loss in tonnage and in the yield of sugar. Any condition which interferes with the proper development of the leaves, either by reducing their size or by prematurely destroying them, in whole or in part, tends to reduce the sugar content of the beet, both directly and indirectly; directly, because all sugar is first formed in the leaves under the influence of heat and light; and indirectly, because, when the leaves are injured or destroyed, the tendency is for new leaves to be formed, and this takes place at the expense of the sugar stored in the root. The root acts only as the storehouse for the sugar and plays no part directly in its production.

Three conditions especially harmful to the sugar beet are drought, excessive moisture, and alkaline soils. A deficient supply of moisture in the soil at any time during the growing season often permanently injures the plants so that their normal development is impossible. The earlier in the life of the plant that this injury is produced, the more harmful are its results. It seems to be practically impossible for beets to recover entirely from a serious injury of this kind. On the other hand, excessive moisture in the soil may result in an abnormal development of the top at the expense of the size or quality of the root, or even in the decay and death of the plant. This latter result is often hastened by the action of parasitic fungi, especially if an excessively wet period follows a period of marked dryness. Although the sugar beet is capable of withstanding the effects of a larger percentage of alkaline substances in the soil than most of the other economic plants, there is a limit beyond which the health of the plant is seriously affected, especially during the early stages of growth.

The most destructive parasites on the beet are insects, fungi, and bacteria. Insects may be injurious to the beet directly by attacking some part of the plant; indirectly, by acting as carriers of fungous

spores or bacteria, or by so injuring the leaves or roots of the beet that fungi and bacteria find ready entrance into the tissues of the plant. It is claimed by some investigators that nearly all the attacks of certain forms of fungi are preceded by injuries produced either mechanically, as in the operations of cultivation, or by insect bites. In their direct influence upon plants insects are treated from the standpoint of entomology, and therefore will not be considered in this connection.

The diseases of the sugar beet that have done the most serious damage during the past season (1901) are the following: Damping off; curly top or blight, sometimes called Western blight, bacteriosis, or California beet disease; leaf spot, leaf rust, leaf scorch, crown rot, root rot, scab, and gall, or crown gall. Other diseases have done more or less damage, but as a rule they have been somewhat local and less serious in their results than those mentioned. It should be stated in this connection that considerable work along the line of sugar-beet diseases is now in progress under the direction of the United States Department of Agriculture, the results of which are not yet ready for publication. In addition to the work that has been undertaken by the writer, some important investigations are being carried on by Mr. George G. Hedgcock, of Lincoln, Nebr., a scientific aid in the Bureau of Plant Industry. The results of these investigations will be made public as soon as definite practical results are reached.

#### DAMPING OFF.

During the past season one of the most potent factors in producing loss and inconvenience to the beet growers in many beet-growing sections was the so-called damping off of the young plants at or below the surface of the ground soon after they came up and before they reached their first cultivation, or even before they were thinned. The cause or causes of this disease are not definitely known. It may be due to a so-called damping-off fungus, or it may be due to unfavorable conditions of soil or weather. Unfortunately the work was begun too late last season to determine these points. In any case, the leaves of the seedlings turn yellow, the roots take on a brownish color, and the plants soon fall over and die. It is difficult to know just when the disease begins its attack, but there is reason to believe that the seedlings are often attacked before they have broken through the ground. This is especially true in those sections of the country where the soil is of such a nature that it forms a crust on the surface after the seeds are planted and before they have had time to come up, or even after the young seedlings are up. In such cases fungi need play no part in the destruction of the plants, and often no fungi are found in connection with the dead or injured seedlings. In other beet-growing areas where the soil is such that a crust does not readily form, we frequently



find the young plants dying off. This may be due to a lack of moisture or to the influence of parasitic fungi. Hence, we see that several very different causes may produce the damping-off effect. In case a soil crust is formed it should be broken up as soon as possible. For this purpose the harrow is probably the best implement to use. It should be just heavy enough to break the crust, without doing serious injury to the young seedlings that may have already formed under the crust. Perhaps the weeder will be found useful for this purpose. Some growers use a roller, while others use an ordinary drag. The former is liable to crush or bruise the young plants, while the latter may pull the seedlings out of the ground. Some writers recommend the use of fertilizers, such as phosphorus and lime, to prevent the formation of the soil crust.

If a damping-off fungus proves a serious pest it must be avoided either by crop rotation or by the treatment of the seed or of the soil with a fungicide. In this connection it should be stated that a failure to get a stand is sometimes due to too deep planting. No fixed rule can be given for the depth of planting in all the different conditions of soil in the various beet-growing sections, but experience seems to teach that the seed should not be covered to a greater depth than  $1\frac{1}{2}$  inches.

#### CURLY TOP OR BLIGHT.

This disease, apparently known under different names in different parts of the country, has done more damage, especially in the West and middle West, than all other diseases combined. In regard to the distinguishing characteristics of this disease there is more or less confusion, which arises chiefly from the fact that the various abnormal appearances accompanying the blight may be produced by one of several causes. In general, however, it may be stated that the blighted beets are stunted in growth; the outer leaves die off; the new leaves produced are small, curled or blistered in a peculiar manner; roots more or less woody and provided with numerous fine side roots, giving the beet a whiskered appearance (Pl. XII, fig. 1), while a cross section of the main root shows a more or less intense darkening of certain sets of fibrovascular bundles as soon as the beet is cut. (Pl. XII, fig. 2.) These bundles are arranged in rings within the root, hence the darkened spots seem to be arranged in rings. As already suggested, several causes may conspire to produce a stunting of the beet or a dwarfing and curling of the top. Likewise, several factors may cause the root to assume a woody texture and to produce a darkening of the fibrovascular bundles. Hence, the symptoms mentioned above may or may not be characteristic of the curly top or blight. It is possible that several forms of disease are represented by these characters, or that this disease, so strikingly similar in different sections

of the country, may, under different conditions, be due to different causes. These points can be settled only by further investigation.

Several seasons ago the Spreckels Sugar Company of San Francisco asked a number of prominent specialists in Germany and elsewhere to investigate this disease which they designated as the California beet disease. The results of these investigations were compiled and published by Professor Linhart, with his own views on the subject. The conclusion reached by these investigators in regard to the cause of this peculiar disease varied within wide limits. By some it was thought to be due to hot winds, others concluded that it was due to the action of bacteria, still others considered it the result of thread-like fungi in the leaves or in the crown, while others still thought it due to a condition of the soil, principally insufficient moisture or lack of proper or sufficient food.

At the request of the American Beet Sugar Company, Mr. N. B. Pierce, in charge of the Pacific coast laboratory of the United States Department of Agriculture, investigated the blight in California with a view to determining the cause of the trouble and its remedy. Mr. Pierce arrived at the conclusions expressed in the accompanying letter addressed to the American Beet Sugar Company, and herewith reproduced with the consent of the author:

SANTA ANA, CAL., *June 17, 1901.*

THE AMERICAN BEET SUGAR CO.,  
*San Francisco, Cal.*

GENTLEMEN: In pursuance of my expressed design, I mail you herewith a brief opinion relative to the nature and control of the blighting or stunting of beets. The views expressed are not of necessity conclusive in an investigation of this nature, but present my present opinions based upon the field and laboratory work to date. They are offered for free criticism, in hope I may thus learn their weak points and pursue future studies along the seemingly most productive lines.

(1) I consider that one of the most fundamental sources of trouble in the present system of beet culture in California is found in the use of seeds from beets not thoroughly bred or acclimated to the California climate and its arid conditions. Transpiration is too free under clear skies.

(2) Field work leads to the opinion that insufficient, or too easily or too rapidly lost, moisture of the subsoil is directly responsible for the stoppage in the growth of the taproot and the stunting or blighting of beets where other conditions may be satisfactory.

(3) General fertility of the soil is essential, together with proper culture.

(4) I have found no parasites—bacteria, higher fungi, or insects—which appear directly responsible for the blighting of the beets.

(5) The greatly increased number of basal lateral roots, and the correspondingly elongated root hairs of some blighted beets, may be laid to, or are a natural consequence of, a check in the elongation of the taproot and its normal terminal absorbent laterals.

(6) The downward growth of the taproot of a beet once blighted is apparently not easily renewed by surface irrigation, lateral roots commonly forming instead.

(7) The blackening of the beet I at present believe to be a purely chemical action, probably oxidation, arising as a consequence of insufficient water supply at the



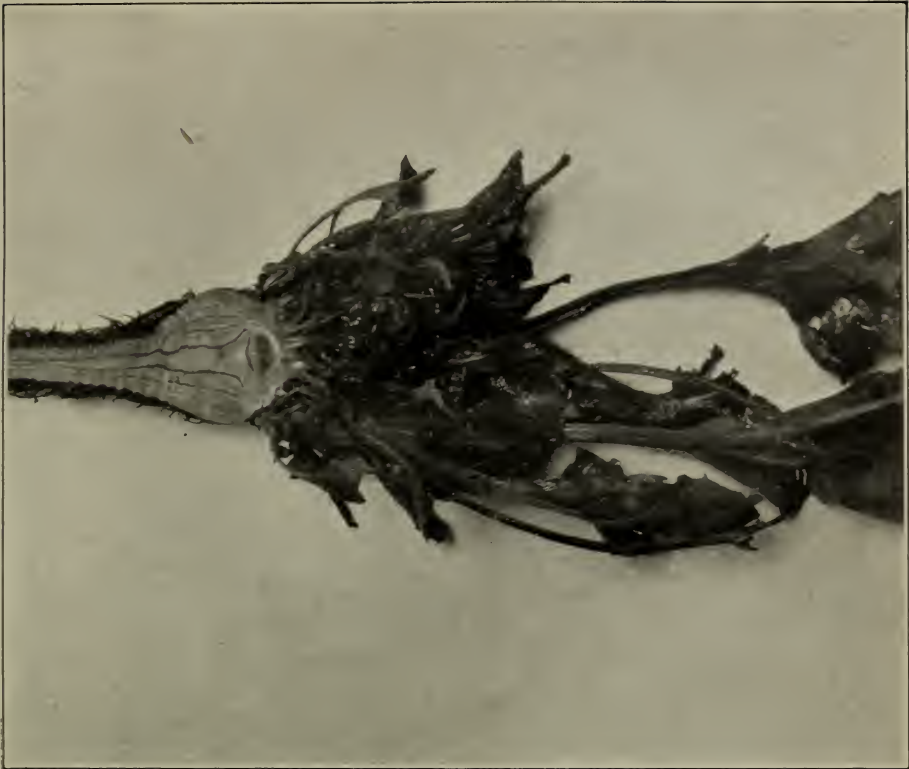


FIG. 1.—A BLIGHTED BEET, SHOWING WHISKERED APPEARANCE.



FIG. 2.—CROSS SECTION OF A BLIGHTED BEET, SHOWING DARKENED RINGS.





proper and timely command of the plant. Chemists may be able to give more special information on this point.

In an attempt to prevent the "blighting" of beets, a serious effort should be made to select and breed beets suited to clear skies, and to pursue this selection for many generations of plants, or, in fact, continuously, thus to bring to bear the laws of heredity. This work should be done under the supervision of men skilled in the production of seed and in the natural sciences, and fully acquainted with the nature of our climate.

In the growing of the beet, in addition to making sure that the fertility standard of the soil is sufficiently high and that cultivation is properly done, it is essential to obtain and retain sufficient subsoil moisture to keep the taproot well supplied from the period of seed germination till the crop is gathered. To obtain the latter desideratum will tax all the resources of your field men. It is not sufficient to add water after the beet has run short at the taproot, as already mentioned. The water should be abundant and constant at the end of the taproot at all times, and should increase in amount below rather than above that point, so that the root is constantly supplied and led downward.

Very sincerely, yours,

NEWTON B. PIERCE,  
*Pathologist in Charge.*

After a careful examination of what is apparently the same disease in the middle West, the writer arrived independently at the same conclusion as Mr. Pierce, viz. that the principal cause of the disease is lack of water supply to the taproot. The following instance will illustrate this point: In some beet-growing sections of the middle West there was considerable blight in 1900, while in those same sections there was little or no blight in 1901. In 1900 a very wet spring was followed by a very dry period extending over several weeks, which in turn was followed by excessive rainfalls, while in 1901 the rainfall was sufficiently uniform to give to the beets a steady and constant growth. The control of the water supply, except in irrigated sections, is not practical, yet much may be done by cultural methods in conserving the moisture in the soil. It is very essential that the beets should always maintain a steady growth from the time of germination to the ripening season. It is possible that this trouble may be overcome by the selection of beets apparently resistant to the disease, since some apparently healthy beets are found in nearly all badly diseased fields. Arrangements have been made for saving the seed from healthy beets on badly diseased fields with a view to originating varieties not subject to the disease.

#### LEAF SPOT.

Leaf Spot (*Cercospora beticola*) was very generally present to a greater or less degree in the Middle and Eastern States and ranked second in point of destructiveness during the past season. Very few fields examined in the sections mentioned were entirely free from it and many were seriously affected, causing considerable loss in tonnage as well as in the quality of the beets, the diseased beets having a lower

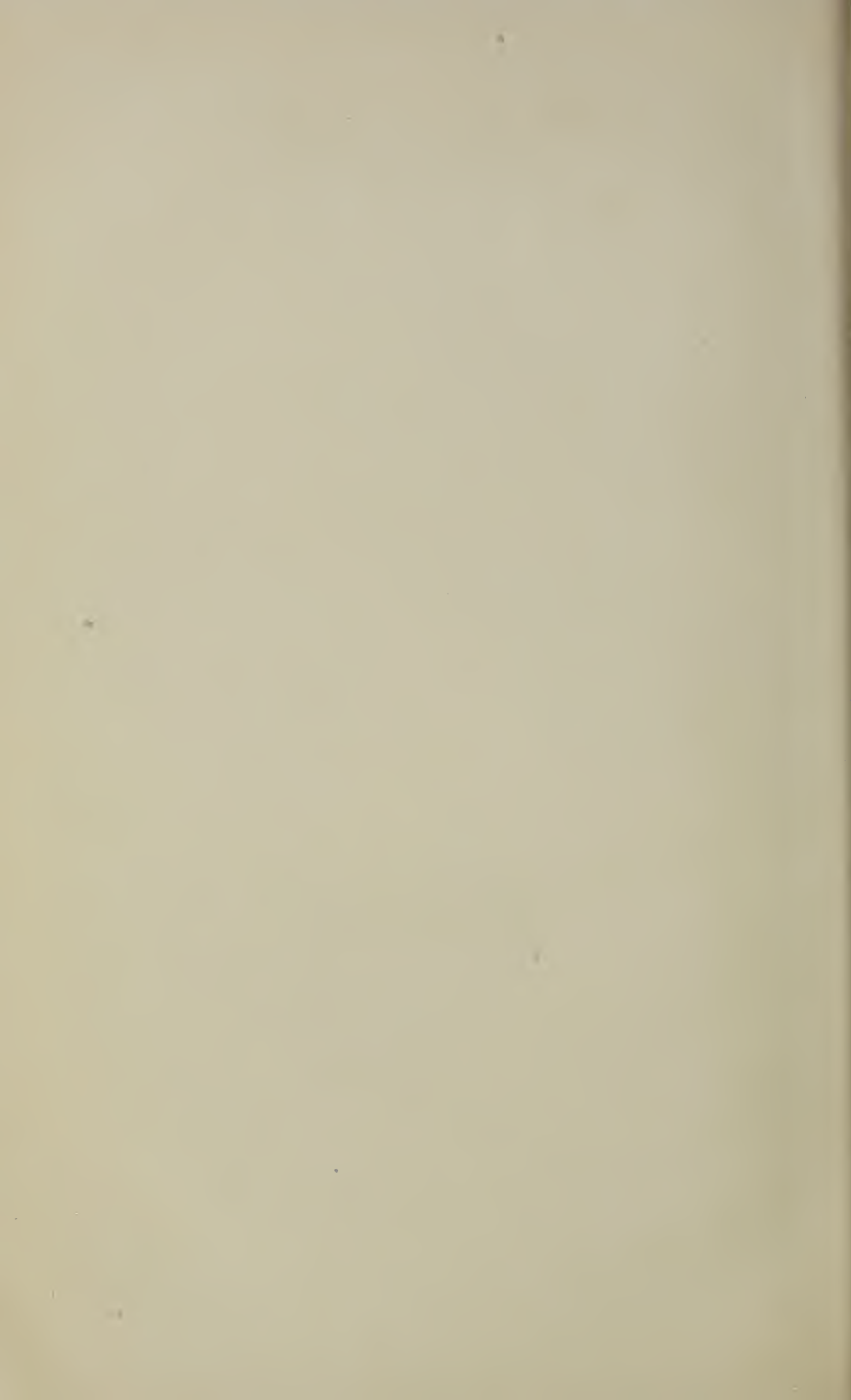
sugar content and a lower coefficient of purity. Leaf Spot is produced by a distinct and well-known fungus, *Cercospora beticola*, which attacks the leaf blades and petioles, producing brown spots with somewhat purple edges. These spots are at first small and nearly round, but increase quite rapidly in size, and when two or more spots meet, an irregular dead brown spot is produced, which is brittle and which often breaks and falls away (Pl. XIII). Eventually the whole leaf becomes affected and dies. The outer or older leaves are attacked first, and, as they die, new leaves are put out from the center of the crown. The result of this process is that the crown tends to elongate and to assume somewhat the appearance of a pineapple; hence the change in shape is often spoken of as the "pineapple" effect of the Leaf Spot disease. As the spots on the leaves advance in age, the surfaces become covered with a grayish coating, which consists of a large number of spores that are easily carried by the wind and other agencies from leaf to leaf and from plant to plant. When these spores lodge upon the green leaves of the beet, under favorable conditions of temperature and moisture, they soon germinate and produce new spots upon which, in turn, new sets of spores are formed, and thus the disease is spread more or less rapidly, depending upon conditions. Attacks of this fungus are frequently noticed when a comparatively dry season is followed by damp rainy weather. In some of the beet-growing sections several distinct attacks were made by this fungus last season, resulting in an enormous loss in tonnage as well as in sugar content and purity of the beets. The plants are seldom killed outright by this disease, but, in addition to the dwarfing of the beet, the elongation of the crown mentioned above greatly increases the amount of tare, since the elongated crown must be cut away in topping the beets. In some beet-growing sections, where the nature of the disease is not well understood, it is thought by some growers that the drying off of the outer leaves due to Leaf Spot is a natural process and not the result of disease. As a matter of fact, practically all the leaves should remain intact until the crop is harvested.

From the nature of the fungus that produces the Leaf Spot, as well as from the work done by Halsted, of New Jersey, and others in the treatment of the disease, it is probable that spraying frequently and thoroughly with Bordeaux mixture will prove to be an effective remedy. The Department of Agriculture has planned a number of experiments along this line to be carried out in different parts of the country, for the purpose of determining to what extent the treatment will be effective and how many sprayings will be necessary to hold the disease in check. A complete account of these and other experiments will be given later when their value has been determined. The Leaf Spot has been most serious during the past season on rather light soil, while but little injury has been produced on the stiffer soils. It is to





LEAVES OF SUGAR BEET ATTACKED BY LEAF SPOT (*CERCOSPORA BETICOLA*).



be inferred, therefore, other things being equal, that it would be safer to use heavier soil, providing, of course, that there is a variety of soils to select from. While we would expect the Leaf Spot to occur on those fields where the disease was prevalent the preceding season, some of the most seriously affected fields seen last year were in areas where sugar beets had not been grown before. This suggests the point that the Leaf-Spot fungus (*Cercospora beticola*) may have other host plants upon which it exists from year to year, and from which it may spread to the sugar beets as soon as favorable conditions arise, or that the fungus spores may be carried over long distances or be transported on the seed. It is apparent, therefore, that a rotation of crops will not prevent attacks of this fungus, although a proper rotation will reduce the probability of serious damage during the first season on a new area. The only sure way to avoid loss from this source seems to lie in the treatment of the plants in such manner that the fungus can not get a foothold, either by spraying the plants or in in some other way that will make the plants resistant.

#### LEAF SCORCH.

Considerable damage was done by the leaf scorch last year, especially in the eastern part of the United States. The nature of this disease has been investigated by Mr. F. C. Stewart, of the Geneva (N. Y.) Experiment Station.<sup>a</sup> The brown or black leaf margins are the first symptoms of the disease. As it advances, the young leaves at the center of the crown blacken and die, together with the blades of the older leaves. In still more advanced stages the roots show a brown discoloration. In some instances the disease kills the plant outright, but in most cases the diseased plants put out new leaves and survive throughout the season. No parasite has been found in connection with this disease, and Mr. Stewart is of the opinion that the trouble is due to a too rapid transpiration of moisture from the foliage. The result of the leaf scorch is a marked diminution in size of the affected beets, even though they apparently recover from the disease, as they seem to do in some cases. It is found, also, that the sugar content, as well as the coefficient of purity, is strikingly lower in the diseased than in the healthy beets at the harvesting season. Mr. Stewart recommends proper irrigation as a reasonably sure preventive of this trouble in those sections where irrigation is practicable, providing the disease should become destructive in the irrigated regions. In those areas where irrigation can not be practiced, beets should not be planted on light sandy soil, and in dry weather moisture should be conserved by stirring the soil frequently, and especially

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<sup>a</sup> Bulletin 162.



after every shower. Besides the predisposition to disease on sandy soil, it has been found that beets do better and produce a better and purer sugar content when grown on a rather stiff soil.

#### BEET SCAB.

The fungus producing beet scab (*Oospora scabies*) attacks the root only and the diseased beets may be recognized in early stages by the presence of somewhat darker colored, slightly elevated corky spots on the surfaces of the beet roots. These spots, at first small and nearly round, gradually increase in size until eventually they meet and form large diseased areas, sometimes almost covering the entire root, as shown in Pl. XIV, which shows also the contrast between the diseased and healthy portions of the same beet. Beet scab is rather widespread, being found in many parts of the middle and eastern beet-growing States. As already indicated, this disease is due to the presence of a fine and thread-like fungus known as *Oospora scabies*, growing in the tissues of the outer layers of the beet root. This fungus was discovered in 1890 by Thaxter, who proved its causal relation to the scab disease of the potato. Since that time it has been shown by Bolley, and independently, by Arthur, that the beet scab is produced by the same parasite. It is well known that *Oospora scabies* will live in the soil from year to year, and it is therefore easy to reach the conclusion that beets should never follow beets or potatoes if the crop produced is in the least scabby. Repeated efforts have been made to treat the soil infested with scab fungus in such manner as to destroy the parasite, but thus far there have been no satisfactory results. There is practically little danger of introducing this fungus into the soil with the beet seed, since the fungus does not attack the parts of the plant above ground. It is generally believed that this disease, which spreads rapidly and does considerable damage, may easily be avoided by a proper rotation of crops, but there is no definite knowledge, so far as the writer is aware, in regard to the length of time that this fungus will live in the soil.

#### BROWN ROT, OR RHIZOCTONIA ROT.

There are several forms of disease known as root rot, of which the so-called brown rot has been most general and has done the greatest amount of damage. It is spread more or less abundantly over the middle and eastern parts of the United States. This disease has been given considerable attention by Dr. B. M. Duggar, formerly of the Cornell Experiment Station,<sup>a</sup> now with the Bureau of Plant Industry, United States Department of Agriculture. Since the discovery of this disease several other forms of root rot have been observed; hence,

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<sup>a</sup> Bulletin 163, Cornell Univ. Exp. Sta., Ithaca, N. Y.



SUGAR BEET SERIOUSLY AFFECTED BY SCAB.





the term root rot does not distinguish this from other diseases. It has for this reason been called the brown rot; but even this does not serve to distinguish it from other forms of disease; therefore, since it is produced by a distinct fungus, *Rhizoctonia betæ*, it is probably best to designate this rot as the rhizoctonia rot. Dr. Duggar describes this disease as follows:

Under favorable conditions the rhizoctonia root rot generally secures its foothold at the bases of the leaves. These parts are moistened with the slightest rain or dew. Inoculation experiments show that in those regions the disease "takes" very readily. The first evidence of the attack is manifested in the blackening of these leaf bases, the outer leaves first, so that the stalks soon become unable to support the blades and the leaves may lie prostrate on the ground. The leaves do not, however, lose their green color very readily. The disease soon works into the crown and root proper, causing the infected parts to turn brown. With further spread of the fungus in the root regions cracks appear in the root (Pl. XVI), and if the conditions continue to favor the development of the disease the whole top gradually rots away and the beet finally disappears.

As a preventive of the Rhizoctonia rot, Dr. Duggar suggests the use of lime or other alkaline substance, on the theory that the fungus requires an acid medium on which to grow. The question of a satisfactory preventive has not been fully worked out, and it is the purpose of this Department to determine the nature and quantity of substances best suited to control the disease.

#### ROOT GALL.

This disease, known for more than fifty years in Germany, has appeared in a few of the beet-growing sections of this country. The galls usually form upon the upper part of the root, sometimes one, sometimes several, upon the same root. One large gall, typical in position and appearance, is shown in Pl. XV. These outgrowths vary in size from that of a pea to 6 inches or more in diameter. When the galls have once started they continue to increase in size with the age of the beet. Although this disease has received considerable attention from several investigators, the cause of the trouble has not been definitely determined. By some investigators it has been ascribed to the action of insects, while others hold that it is due to the presence of fungi, and still others think it is due to unfavorable conditions of soil and climate. The result of this disease is to reduce the size as well as the quality of the affected beets. Experience shows that beets grown in soil where the disease has previously appeared will be affected usually more seriously with each succeeding crop, hence rotation should be practiced wherever the root gall appears, at least until the matter can be further investigated and some satisfactory remedy found. It should be stated that rotation is not always necessary nor desirable.

## CONCLUSIONS.

The main problems which present themselves to the grower of sugar beets from the standpoint of disease lie along the line of prevention rather than cure. Prevention must be considered from two standpoints: First, the prevention of the introduction of diseases from other beet-growing countries; second, the prevention of the annual attacks of diseases already established in the beet fields of our own country. It is possible that diseases may be introduced from foreign countries through the importation of foreign seed, and it would be very desirable if all sugar-beet seeds could be treated for the destruction of fungous spores before planting. The seeds should be treated by the growers themselves or by some competent person just before the seeds are planted. While it is true that the proper treatment of the seed balls with suitable fungicides will greatly diminish the possibility of the introduction and dissemination of disease through the agency of seeds, the most satisfactory fungicide to be used for this purpose has not yet been clearly established. Investigations are now in progress along this line. It is necessary that the fungicide employed should be effective in destroying the spores without injuring the germinating power of the seed, that it should be inexpensive, and that it should be of such a nature as to be easily and safely used by the grower. Various forms of fungicide, such as copper sulphate, carbolic acid, formaldehyde, lysol, sulphuric acid, etc., have been used in the treatment of beet seed by different investigators with varying results. In most instances a 1 per cent solution of carbolic acid seems to have been reasonably satisfactory from the standpoint of spore destruction, but the objection raised against it is that it is too expensive for practical purposes. The same objection is made to some other fungicides. Again, while some substances are inexpensive, they are often but partially successful as spore destroyers or are injurious to the seed.

In efforts to prevent the attacks of prevailing diseases of the sugar beet from year to year, several methods present themselves, all of which may be useful: (1) The seed should receive consideration, whether grown at home or abroad; (2) conditions point to the importance of producing varieties of the sugar beet that shall be resistant to at least some forms of disease; (3) the treatment of the foliage is of prime importance, especially in those sections where leaf spot and other diseases of the foliage produced by parasitic fungi are prevalent; and (4) the treatment of the soil should receive careful and prompt attention. This is placed last not because it is considered of least importance, for in some sections it is all-important. Indeed, it is of more or less importance, either directly or indirectly, in the consideration of diseases wherever sugar beets are grown. The same treatment,



SUGAR BEET WITH LARGE GALL.





however, can not be established for all places, even where the same disease occurs. Sometimes it is a case of drainage, sometimes a case of irrigation, of fertilizers, of fungicides, of seed treatment, or of the development of resistant varieties. These are some of the problems that are at present confronting those who have in charge the investigation of the diseases of sugar beets. The results of these investigations will be made known to those interested in the growing of sugar beets as soon as definite conclusions are reached.

### **SUGAR-BEET SEED: PRODUCTION AND TESTING.**

By A. J. PIETERS, of the Bureau of Plant Industry.

In the case of no other crop is the success of large operations and the profitable investment of millions of capital more dependent upon the quality of the seed than in that of the sugar beet. European sugar producers have realized this for many years, and the American manufacturers are becoming more convinced of it every season.

#### **IMPORTANCE OF USING FIRST-CLASS SEED.**

The importance of using first-class seed has been so well brought out by Henry W. Diederich, consul at Bremen, Germany, in Consular Reports, No. 242, that I can not do better than to quote a part of his report:

Sugar is made not in the sugar factories but out in the fields. Therefore, it is impossible to pay too much attention to the cultivation of beets containing the highest proportions of sugar, and, at the same time, with the largest tonnage per acre. In order to produce such, the selection of suitable soil, the climate, the rainfall, and length of season, the fertilizing and planting, the cultivating and harvesting—all are very important factors. But the most important of all is to start out with the best seed obtainable; for good seed, after all, is the foundation of successful sugar industry. If I may express an opinion, based on my personal observation, it is that some of our beet growers should insist more than they have upon getting none but the best of seed, no matter what the price may be. \* \* \* The first-class sugar factories of Europe buy none but the very best seed, grown from high-grade individual “mother” beets, to distribute among the beet growers; thus not only maintaining the standard of their sugar beets as to quality and quantity, but also putting themselves in a position to compete in all the markets of the world. This first-class seed is sold and delivered by the growers on board cars in the Prussian province of Saxony at from 8 to 10 cents per pound, which is a moderate price, considering the fact that it takes at least four years to get it into the market.

There is also a second-class seed offered for sale in this country at from 5 to 6 cents per pound. This is commonly called the “nachzuchtsamen,” being a seed produced not from the mother beets, but from the first-class seed mentioned above. This inferior grade, however, is not used by first-class sugar men in Germany, France, Holland, and Belgium, but most of it goes to Austria, Russia, and the United States. And this is the reason why I deem it my duty to call attention to the importance of getting only the very best seed obtainable. In my opinion, those American growers of sugar beets who buy cheap grades of seed make a great mistake. All kinds of

seed have a natural tendency to degenerate. Even the first-class beet seed mentioned above will not bring forth beets that come up to the standard of the original or mother beet, but will show a loss of one-half to 1 per cent of sugar content. Now, the second generation of seed will degenerate more than as much again, and lose from 1 to 2 per cent. This is a small amount, when considered by itself, yet it is sufficient not only to turn the profits of a sugar factory into a loss, but even to drive the concern to the wall.

To illustrate this: Factory A slices 50,000 tons (short) of beets, which would yield about an average of 15.5 per cent sugar in the extraction. After deducting the sugar left in the molasses and in other waste, this would leave about 13 per cent—6,500 tons of pure granulated, marketable sugar, which, at \$50 a ton, would net \$325,000.

Factory B slices the same amount of beets, grown from second-class seed, which, at a fair average, have about 1.3 per cent less of sugar in the extraction. After this material has also gone through the process of refining there will be 11.7 per cent—5,850 tons of marketable sugar, which, at \$50 a ton, would net \$292,500.

It will be seen at a glance that, while both factories use the same amount of material and have the same expenses for labor, fuel, etc., there is a difference in the gross receipts for manufactured sugar amounting to \$32,500.

Factory A bought 55 tons of first-class seed, at \$180 per ton, \$9,900; Factory B bought 55 tons of second-class seed, at \$120 per ton, \$6,600. It will be seen that Factory B wanted to buy "cheap" and to make money fast. It did, indeed, save \$3,300 at the start; but Factory A began by planting the very best seed obtainable, and came out at the end of the season with \$29,200 cash ahead of its competitor, and was in the position of declaring a handsome dividend.

Like so many other things in life, the cheapest beet seed is the dearest. It pays to get the very best, and only the very best is good enough. Let the good work of experimenting in the field of sugar-beet culture continue, in order to learn exactly what we can do in the face of fierce and growing competition; but let American growers determine not only to try different varieties of seed, but also to plant none but seed of high grade and pure pedigree.

It is evident that, if the profitable operation of a sugar factory may depend upon a difference of 1 per cent in the sugar content of the beets, it is of the utmost importance that the seed used should be the best obtainable and that it should also be adapted to the climatic and soil conditions obtaining in the sugar belt of the United States. At present almost all the sugar-beet seed used in the United States is imported from Germany, only a small amount being grown in this country. Judging from the acreage that it is estimated will be planted in sugar beets in 1902, about 2,400 tons of seed will be required. Of this amount less than 100 tons will probably be produced in the United States, the greater part of that in Colorado and California.

The price paid for imported seed varies from  $7\frac{1}{2}$  to 17 cents per pound, the average price paid by most factories being about 9 cents, delivered in Chicago or Omaha. It costs in the neighborhood of 4.5 cents to grow a pound of sugar-beet seed in France or Germany, but chiefly because of the greater cost of labor in the United States domestic seed can not be sold as cheap as foreign, California growers receiving 10 cents per pound, exclusive of freight charges.



## EXPERIMENTS WITH IMPORTED AND HOME-GROWN SEED.

Some years ago the United States Department of Agriculture established a station for growing beet seed at Schuyler, Nebr., where 5,000 tested mothers were planted in 1893. The station being abandoned, the seed produced was sold to the highest bidder. Several experiment stations have also done more or less work along this line, the stations in Colorado, Nebraska, Illinois, Indiana, and Minnesota being at present actively engaged in this work. At the Colorado station the tests made with imported and domestic seed resulted favorably to the latter. The results of these experiments are given in Bulletin No. 51 of the Colorado Agricultural Experiment Station, from which we quote:

An extensive series of tests was made of beet seed grown in the United States as compared with seed grown in Europe. Six varieties were used; one grown in France, one in Saxony, two in Germany, and two in the United States. The sources of the seed are as follows:

1. Utah Kleinwanzlebener: This seed was grown at Lehi, Utah, by the Utah Sugar Company. The seed first used was the Original Kleinwanzlebener, from Germany, and the seed tested this year was the second generation of American seed grown from the German seed.

2. Original Kleinwanzlebener: Imported from Germany and sent to us by the Utah Sugar Company. Of course this was not the identical seed that was used as the ancestor of the Utah Kleinwanzlebener seed above mentioned, but it is from the same seed farm, of a crop a few years later, and is presumably of about the same quality.

3. Vilmorin: Sent us by the United States Department of Agriculture and imported by them from the original growers in France.

4. Mangold: Grown by M. Knauer, Groebers, Saxony, and imported for us by the agent, H. Cordez, Lagrande, Oreg.

5. Eddy Kleinwanzlebener: This seed was grown at Eddy, N. Mex., during the season of 1897, from the beets of 1896, that were grown from seed obtained from Maison Carlier, Orchies, North France. It is, therefore, the first generation of American seed from the original French seed. This is the first crop of seed raised at Eddy.

6. Elite Kleinwanzlebener: Imported from Germany by the United States Department of Agriculture. Seed of these six varieties was sent to quite a number of persons in the various irrigated portions of Colorado who had promised to take special pains in the test. Some of the tests were to be on a small scale with the richest of ground and the best of conditions. Another set of tests was to be made on a larger scale under general farm conditions.

The results of the experiments are tabulated, and the conclusions drawn from these are as follows:

A comparison of the results from the different kinds of seed shows, first of all, that they are all good seeds. An average of 25.1 tons of beets per acre, testing 15.57 sugar and 81.3 purity, is a very high yield. There is, however, considerable difference in the results from the different varieties. The Elite Kleinwanzlebener and the Vilmorin were sent us by the United States Department of Agriculture as the best beet seed that they could get. The original Kleinwanzlebener was selected by the Utah Sugar Company as, in their judgment, the best brand of seed on the market from which to raise their own seed. If we take the average of these three first-class seeds and compare it with the seed raised in Utah, the comparison is in favor of the Utah-

grown seed in per cent of sugar and purity, while the crop per acre is equal. The Utah seed is therefore superior in pure sugar per acre and in available sugar per acre. The Utah seed is superior to the seed from which it is descended in sugar and purity, but a little inferior in quantity of crop.

The seed grown at Eddy does not give so good results as the Utah seed, but it equals the Vilmorin and is not far behind the Original Kleinwanzlebener. The germinating quality of the seeds is quite satisfactory. The four Kleinwanzlebener varieties give 87 per cent of stand, while the Vilmorin gives 80 per cent and the Mangold 75 per cent.

In the light of these experiments there can be no doubt that sugar-beet seed can be grown in the United States fully equal to the best of the imported seed.

In the experiments at Scuyler it was shown that the domestic seed gave crops of 21.1 tons per acre, while the imported seed gave but 17.9 tons, and that the amount of sugar produced per acre was 12 per cent greater from the domestic than from the foreign seed.

#### PRODUCTION OF SUGAR-BEET SEED IN AMERICA.

The beet seed grown by private enterprise in Colorado and California is all used at or near the place of production. That the seed produced gives satisfaction is abundantly attested by the fact that the growers are increasing their acreage as rapidly as possible. The Utah Sugar Company of Lehi, Utah, which began to grow seed in a small way some years ago, produced 40 tons in 1900 and had an increased acreage in 1901. J. B. Agnew, a seed grower of Agnews, Cal., produced 25 tons in 1900. So far, wherever home-grown seed has been used in comparison with imported the sugar content of the resulting beets has been higher than that from imported seed. In Washington State, where the production of sugar-beet seed has recently been begun, the results have been especially striking, as will appear from extracts from a letter written by E. H. Morrison, of Fairfield, Wash. Mr. Morrison sent samples of home-grown and imported seed to be tested for germination. The results of the tests showed that the domestic seed had much better vitality than the imported seed.

#### *Tests of imported and home-grown seed.*

	Domestic.	Imported.
Percentage of purity.....	96.12	90.9
Sprouts from 100 balls in 6 days.....	191.5	100.
Sprouts from 100 balls in 12 days.....	197.5	112.
Percentage of balls sprouted in 6 days.....	93.	53.5
Percentage of balls sprouted in 12 days.....	93.	53.5
Sprouts from 1,000 grams of seed in 6 days.....	114,600	71,000
Sprouts from 1,000 grams of seed in 12 days.....	119,000	80,800

Regarding this seed, Mr. Morrison said:

Of the two samples sent you, the one marked "No. 1" was home-grown crop of 1901. Sample No. 2 was Kleinwanzlebener Original, said to be the best imported seed of the crop of 1900. The seed marked "Domestic" was grown from beets of Kleinwanzlebener Original seed. The physical selection of the mothers was made by

my foreman, who has had, as I said above, twenty years' experience in seed raising in Europe. The selections were made with great care from a field of 120 acres that gave an average factory return of 20 per cent sugar and a purity coefficient of nearly 90, many individual beets showing 24 per cent of sugar.

The beets I raised this year from my own seed, for the Waverly factory, gave me an average factory return of 19.9 per cent sugar and a purity of 88. The beets in the same field from Germany, Kleinwanzlebener Original, averaged 18.59 per cent sugar and 85.67 in coefficient of purity.

My experience indicates that this section of Washington is well adapted to growing beet seed of a superior quality. In the first place our beets generally have a high percentage of sugar and purity. Then, again, we have a long, warm, cloudless summer for the maturing of the seed. So far my average has been about 1,500 pounds of seed to the acre. I think by the use of fertilizers and better preparation of the soil, and with a favorable season, that this could be increased to 2,000 pounds per acre. \* \* \*

I inclose copy of analyses of beets sent by me to Professor Fullmer, of the Pullman Agricultural College, in 1895, simply to show the purity of the beets grown in this vicinity, which certainly should enter as a factor in producing high-grade seed:

*Results of analyses of beets grown in Washington.*

Weight of beets.	Sugar in beets.	Sugar in juice.	Coefficient of purity.
<i>Ounces.</i>	<i>Per cent.</i>	<i>Per cent.</i>	
11	22.4	23.6	92.9
11	21.9	23.0	93.1
14	20.6	21.7	93.5
13	20.1	21.2	92.2
25	19.9	20.9	86.7
14	19.5	20.5	90.7
30	18.6	19.6	94.2
20	18.2	19.2	90.1
24	18.0	19.0	89.6
16	17.3	18.2	85.4
23	17.1	18.0	92.3
18	16.9	17.8	92.2
17	16.5	17.4	88.3
16	16.3	17.1	87.7
16	13.8	14.6	88.5

The beet-sugar industry is now so well established in the United States that it would be poor policy to depend longer on imported seed. The possibility always exists that by failure of the crop or by reason of political or trade disturbance the supply of seed may be cut off; but even if this possibility be regarded as remote, it is nevertheless true that American sugar factories will never attain their maximum profit until we have beet seed especially produced to meet American conditions. The problem which the Department of Agriculture will seek to solve is where sugar-beet seed may be grown to give the best results under the varying conditions prevailing throughout the sugar-beet belt. Experiments have been undertaken for the production of sugar-beet seed in cooperation with the State experiment stations. These experiments will be conducted according to the best commercial methods



and on a scale sufficiently large to throw light on the problem of beet-seed production in the United States.

#### TESTING SUGAR-BEET SEED.

Only second in importance to the care with which a strain of beet seed has been selected is the vitality of the seed. The matter of testing beet seed for purity, moisture content, and germination has therefore received a great deal of attention abroad, and one of the chief duties of the seed control station is the testing of sugar-beet seed. Standards have been adopted by a number of societies and stations, but, of these, two are the most important—the Magdeburg standards, which are in use throughout Germany, and according to which American factories usually buy, and the Vienna standards, which are maintained by the Government experiment station at Vienna, Austria, and are in force throughout the country. When seed is sold subject to either standard and fails in any particular, it may be refused. These standards are, however, not adequate protection for the American buyer, so long as he must use imported seed. The ocean voyage always has an injurious effect on the vitality. Seed that left Germany up to grade may not show standard test when delivered in the United States, and it is difficult in case of a difference between the first and second test to effect a settlement. With home-grown seed such trouble would not be experienced, differences could easily be adjusted, and there would not be, for many years at least, a temptation to sell old seed for new, because the demand will for a long time exceed the supply. The methods in use in the seed laboratory of the Department of Agriculture are identical with those used by the best German stations. The balls are soaked for about six hours and are then placed between blotters wet with filtered water. They are then put in chambers where they are kept for six hours at a temperature of 40° C. and for eighteen hours at 20° C. The first count is made after six days and this is reported as the preliminary report. The test is completed in twelve days.